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AMERICAN WATER WORKS ASSOCIATION

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VOL. 5 DECEMBER, 1918 No. 4

CONTENTS

Comments. What Interests Water Works Men Most.... 395

De-Hydrated Contracts. By Albert P. Greensfelder.... 404

Lead Pipe Couplings. By J. A. Jensen..... 407

Office Records of the St. Louis Water Division, Distribution Section. By Thomas E. Flaherty..... 412

Reinforced Concrete Pressure Pipe. By Coleman Meriwether..... 419

Significance of Black Sands in Filters. By J. E. Welker and C. C. Young..... 425

Memoranda of Office Records. By W. A. Cuddeback.... 429

Water Pollution and Fish Life. By Victor E. Shelford.. 434

Water Treatment at Council Grove, Kansas. By Louis L. Tribus..... 438

Records of Installation and Maintenance of Water Mains and Appurtenances of the Municipal Distribution System of the City of New York. By William Hauck 448

The Property of Certain Waters With Reference to their Action on Metals. By S. W. Parr..... 451

Society Affairs..... 454

Index..... 457

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The Association is not responsible, as a body, for the facts and opinions advanced in any of the papers or discussions published in its proceedings.

VOL. 5 DECEMBER, 1918 No. 4

COMMENTS

WHAT INTERESTS WATER WORKS MEN MOST

At the St. Louis convention the proposal to make the JOURNAL a more useful publication met with warm approval. To do this makes it necessary for the Publication Committee to try to solve the old and troublesome question of what interests water works men most. The technical journals have their editorial representatives traveling about all the time, meeting the men who are in charge of all kinds of work and thus learning what they wish to know as well as what they are doing. They succeed as they keep in touch with their field in this way, and they fail as they edit their journals from the office chair alone. Each member of the Publication Committee is busily engaged in solving his own problems of administration and construction and investigation; none has time to travel about on editorial work. Consequently, at the outset of the new duties put upon the Publication Committee, the members of the Association should let the Committee know what, in their opinion, is the field in which water works men take most interest.

It is a most troublesome and bewildering experience to spend long study and carry on protracted correspondence in order to write a comprehensive summary of the present views held on a subject of really great importance, only to find that this report is regarded as a dead issue. Such an experience is not likely to encourage those who have had it to renewed activity of this character. For example,

take the report of the Committee on Depreciation. After a great amount of correspondence and study, the committee prepared a report which was submitted at the Richmond convention, along with a minority report by one of its members. The subject was so important and the report was known to be the result of so much effort, that rather than take hasty action on it, the report was ordered printed and distributed to the members and placed on the program of the next convention for final discussion and action. But at St. Louis the matter had been so forgotten that no action was taken in accordance with the vote of the Association the year before, and the fact that the committee had been discharged at its own request at Richmond was overlooked. As a result one of the most important reports made to the Association still remains without action and existing only in pamphlet form.

This report was a subject of great interest at Richmond; it was a dead letter at St. Louis. What then should be the guide of the Publication Committee in determining matters of interest to the members of our Association? Letters from acquaintances tell what interests them; I know what interests me. But one man's circle is a small one; the Committee wishes to know what interests water works men all over the country, so it can make the JOURNAL a very live help to them, whether they are managing a small plant or managing the water supply of a great city. The Committee cannot send a letter of inquiry to every water works man in the country about this matter. But every member of the Association who feels that a live journal will be useful to him should let the Publication Committee know how it should be changed to make it more serviceable to him personally.

A. W. CUDDEBACK.

CONSERVATION OF WATER SUPPLY BY WATER WASTE PREVENTION INSPECTION

The participation of the United States in the World War has more forcibly than ever before impressed water works officials with the necessity of conservation of water supply. The federal authorities responsible for the prosecution of the war are daily urging the use of what was formerly wasted, to reduce the demand for labor and materials. The water consumption of communities is being studied to determine whether undue waste of water exists, and if so, a de-

mand is made to curtail such waste. Coal is to be allotted on the basis of the actual water needs of cities with waste stopped, as far as practicable. Whether our federal representatives have or have not taken action on the fuel allotment of a given community, all should be interested in water supply conservation for one of the following reasons:

a. To avoid shortage in supply, due to abnormal growth in consumption, on account of war activities.

b. To conserve fuel and labor, where pumping of the water is necessary.

c. To relieve the overload on delivery mains, filters and other essential parts of a water supply system which cannot be duplicated under war conditions.

Emphasis has in the past been, and is now being, laid on the use of meters to reduce the demands for water, by checking waste. Only slight effort has been made to direct attention to the excellent and almost immediate results in water waste prevention that can be obtained from house to house inspection. Under present labor and material conditions it is both difficult and expensive to obtain and set meters. By the expenditure of a small fraction of the labor necessary to install the meter, the premises can be examined and plumbing repaired, to prevent waste from leaks. It is estimated that in generally unmetered communities, water can be saved by a yearly inspection of the premises at a cost of approximately $5 per million gallons. No additional water can be obtained at a price that even approaches this figure.

The water works superintendent should not neglect the possibilities of conserving his supply and reducing his operating expenses, through the periodical examination of plumbing within the houses. New York and Buffalo have recently found that many million gallons daily, and tens of thousands of dollars annually, are saved by the inspection of premises to detect and stop leaks. Men for this work may be readily trained and immediately secure results. By their use the careless, wasteful consumer is made to save the water that his careful and conscientious neighbor pays for.

It is not intended to create the impression that house to house inspection should be considered as a satisfactory permanent substitute for general metering. The measurement of and payment for water furnished can only be equitably based on records of meters attached to each premise. There is no water waste preventive

equal in efficiency to a meter, but there may be many reasons why meters cannot be installed. The examination of water fixtures by inspectors is now urged as a valuable aid in reducing water consumption during the period which must elapse before meters can generally be installed under the war time conditions existing in this country.

W. W. BRUSH.

WRITING FOR PUBLICATION

Every experienced superintendent is confident he can edit his favorite trade paper better than it is now edited, at least in some particulars. Yet the fact is that the publishers of trade papers, whose success depends upon their ability to produce publications which large numbers of specialists like enough to buy, use only a very small part of the information in the articles presented by these specialists before technical societies. Furthermore, there are only a very few technical societies which publish journals that even pay expenses, unless a wholly unreasonable proportion of the annual dues are assumed to be paid solely for the journals. The societies, such as the Society of Chemical Industry, which publish profitable journals, conduct this part of their activities precisely like the publishers of trade journals. Therefore it is reasonable to believe that the methods of editing a successful trade journal are worth explaining at this time to the members of the American Water Works Association, for our printers have been compelled to increase their charges for publishing our JOURNAL about one-third, and it is necessary to adopt more economic methods in preparing papers for presentation and publication, in order to keep well within the budget for printing expenses. Furthermore the War Industries Board has ordered the amount of paper used in the JOURNAL reduced about 20 per cent.

There are two entirely distinct classes of papers published by technical societies. The first class is essentially news; it describes work planned, or under construction, or done. The second class is scientific; it describes investigations, analyzes the reasons for success or failure of methods of design or construction, reviews the state of some particular art or practice, or discusses those principles of economics which underlie sound business administration.

News articles must be brief. Fifteen years ago, it was the practice, even in trade papers, to embalm the kernel of news in a husk of

everyday knowledge, so that we were forced to waste our time needlessly in acquiring new information. James H. McGraw saw the mistake of this custom, and was the first leader among American publishers of trade papers, to insist that the news should be printed without the platitudes. Every reader of a trade paper owes him thanks for saving their time by starting this reform. We can waste money and yet earn more, but we cannot get back the time we waste, and we are wasting our most precious asset in padding news articles, in addition to wasting the time of the readers of them who have to read the superfluous paragraphs.

There is another feature of this subject that every man holding a technical or administrative place should keep in mind. Much of the best news, particularly in the water-works field, can be written on two or three sheets of paper. This is easily done; it results in something others in the same field desire; why not do it now and let the members of our Association share this interesting information, instead of putting it off until there is an opportunity to wrap the news in the old-fashioned husks? Why not openly confess that while examining the journals of many technical societies we long for some sort of literary gas mask?

The second class of articles, that dealing with scientific subjects, is a large one and has so many aspects that only the most general suggestions regarding it can be made here. Obviously the best method of presenting the results of special research is different from the best method of reviewing the state of an art, yet there are certain principles that govern the editorial staffs of our best trade papers which should govern everybody who writes on a technical subject. These are:

1. Have a clear knowledge of the viewpoint of the class you wish to read your article. You are not trying to get information out of your head; you are trying to get it into their heads; hence use the best way into them.

2. Don't give an unnecessary fact or make an unnecessary explanation of minor details. Assume that the reader possesses as much knowledge as you have, except of the new thing, and tell him about that only.

3. Tell the story in the clearest way by words, drawings or pictures, but tell it only once. Don't give both tables and curves; one is enough for practically every reader and let the hundredth man write to you for the omitted details that all the others do not

wish. Think of the time and printing charges this saves. Don't describe in words what is perfectly clear in illustrations; don't repeat in words what is given in detail in tables.

4. Don't give unnecessary tables; assume that the reader will grant that you know how to add and subtract, and is interested only in totals, as a rule. Prepare your tables so that they will occupy the smallest amount of printed space and still be clear. Look at tables in the publication for which you are writing, see how many figures can be put on a line in the column or the page, and arrange your tables accordingly. Otherwise somebody must rearrange them for you, and probably make mistakes in doing so.

5. Send drawings that can be photoengraved and save the Association the expense of making drawings for the purpose. Never use colors on drawings for photoengraving. Remember that if a drawing must be reduced to one-third, say, of its size to be printed on the page, each line and letter on the drawing must be three times the size it is to be on the engraving. Use only two sizes of lettering on such a drawing, one for the text and one for the very few titles sometimes necessary. Don't give a line or a word not absolutely necessary. If the drawing has a single detail that is much finer than all the rest, make an outline of this detail on the main drawing and then, on a larger scale, give the detail; this will enable the general drawing to be photo-reduced to the size it should have in the engraving and will also give the detail in legible form, a great help to the reader and a saving of expense to the Association.

6. Remember the many times you have wondered why the JOURNAL was padded with so much useless stuff; don't pad. Remember how many times you wished for news about some improvements or some piece of work; send the JOURNAL your own news or tell the Publication Committee what you wish. Remember that nine-tenths of good technical practice is the result of sound judgment and only one-tenth depends upon demonstrable facts; help others with the practical knowledge upon which good judgment rests, just as others are helping you.

JOHN M. GOODELL.

BURNING SMALL SIZES OF ANTHRACITE

Many years ago the late Eckley B. Coxe, the noted mining engineer and coal operator, saw the approach of much higher costs of pro-

duction in the anthracite fields. He also saw the enormous waste of coal through failure to develop practical methods of burning the small sizes which were then rarely used. For many years he worked over this problem and finally developed a practicable furnace and grate for burning these small sizes, but as the time was not then ripe for its use, it was forgotten by most power plant specialists. Recently the high price of larger sizes and the difficulty of securing deliveries of them have made the use of small sizes highly desirable, and this old invention has again come into prominence. The Philadelphia Water Bureau has been one of the pioneers in this new practice, which is of real significance as a matter of national economy. From the best data available the use in Eastern Pennsylvania of these small sizes of anthracite, commercially known as No. 3 and No. 4 buckwheat, has doubled in the last four years. In other words, about 2,000,000 tons annually of fuel which formerly went to waste is now being used in power plants.

The Philadelphia Water Bureau has installed twenty Coxe stokers in the past four years under boilers aggregating in rated capacity 8400 horsepower. A combined efficiency of 70 per cent at 125 per cent of boiler rating has been obtained in all tests with No. 3 buckwheat coal having a heat value of 11,000 B.t.u. and carrying approximately 23 per cent of ash. Operating results have approached test conditions in a way that demonstrates the dependability of the stroker and the fact that it can be considered as beyond the experimental stage.

Conditions in the fuel market dictated the original choice of a stoker which could burn anthracite screenings. Prewar prices for No. 3 buckwheat averaged approximately $2.00 a long ton, or rather more than $1.00 a ton less than for bituminous with a heat value of 13,000 B.t.u. and 13 per cent of ash. Broad economic conditions created by the war have more than justified the choice of this stoker, entirely apart from the artificial prices created under the present abnormal situation.

Conditions after the war will apparently open a still wider field for stokers of this type in the contemplated power developments in the mining regions, as well as in the use of low grade fuels which must be largely developed in the future. For instance, Rhode Island lignite has already been successfully burned in an experimental way. The near future will certainly bring radical and permanent changes in all our boiler room practices and methods.

While freight charges will doubtless limit the areas beyond which low grade fuel cannot be economically transported, the chain grate stoker of the Coxe type apparently opens one practical line of investigation for many water works superintendents.

CARLETON E. DAVIS.

COAL

There seems to be a considerable misunderstanding of what must be done by the managers of water works and other public utilities to obtain coal. All public utilities have been given a definite classification which gives them preference over many other consumers of fuel. This is a classification which gives a preference under war conditions; it does not mean a preference which will restore the conditions existing in times of peace. Nobody has the slightest justification for expecting that a preferential classification here will remove all troubles any more than our soldiers in Flanders and France had any reason for expecting sleeping cars and limousines to transport them through the enemy's lines. The coal operators are crowded to the utmost and the railways in many sections are congested. Under such conditions, inconvenience is bound to arise and the manager of the public utility who gets along best is he who sees what this inconvenience will be and provides against it.

There have been innumerable complaints from managers of utilities that coal was not delivered when it was desired but came at long intervals in large quantities which could not be stored. That condition is a war time burden which the manager must provide against. In congested districts coal can often be delivered only in large consignments, without interfering with essential war time shipments. The wise manager will provide storage somewhere for this coal; if he does not, a variety of harassing troubles are likely to visit him, and he will receive little sympathy from those who know how strained are the railroad facilities to meet the urgent demands upon them. It is impossible in many places to deliver a car or so of coal at regular intervals, without interfering with so many other necessary freight movements that national economy demands placing upon those heretofore served in this way the provision of increased storage facilities. This is their share of the war burden, so far as the coal situation is concerned.

There is a mistaken idea that the place to untangle complications over coal deliveries is Washington. It is a good plan to keep away from Washington in these days. The Fuel Administration is decentralizing its work so far as possible. A manager short of coal and unable to get help from the local fuel administration should deal with his State fuel administrator. The latter is an extremely busy man, working with a hastily organized force. There are two things which should not be demanded of him. One of these is how to furnish coal on a day's notice in a district where transportation is congested and coal is short. The other is to have such a complete filing system and such a well-organized clerical force that the coal business of a state can be looked after with the detail maintained in a local dealer's office.

In order to have enough coal on hand the manager of a utility must give the State Fuel Administrator ample notice of his needs, he should give full data in each letter so that previous correspondence must not be looked up in the office of the administrator, he should show how much he burned last year and the reason for asking an additional amount this season, and he should use every endeavor to take coal when he can get it and not when he wants it. He must put up with many inconveniences but they are nothing to the daily troubles of the fuel administrators who are trying to help him.

JOHN M. GOODELL.

DE-HYDRATED CONTRACTS[1]

By Albert P. Greensfelder

Contracts are not engineering products but merely recipes for moral behavior. Water works were probably built by the ancients without such entangling alliances. Even today water free from impurities is possible without the introduction of paper documents. Why then are there such impedimenta as contracts?

Civilized anatomies demand water of quality and civilizing industries require water in quantity. Contracts, per se, affect neither of these, any more than do meters and pumping records. There is probably nobody here who, when stating his experience before his prospective employer or examining board, was ever asked if he could write a contract. If such a test were a requirement of water works officials the speaker would greatly fear for the constant supply at our faucets. Thus all will probably agree that contracts are de-hydrated.

If any one present, irrespective of practical construction experience, were asked to adjourn to an adjacent room and, without books or other references, prepare an equitable form of contract in five or even fifty hours, it is probable the results would be neither equitable, legal, nor binding. The task is difficult because it is based on precedent and comparative experience, but it is not impossible, as has been amply proved in other fields of endeavor.

The true purpose of a contract is to express so clearly the intent of those making it that a meeting of the minds of the two parties thereto is absolute. In these days of conservation of man power and wealth the necessity for proper contract forms is more essential than ever before. We must not, dare not, waste effort in these strenuous times. The American Society of Engineering Contractors therefore deems it both a prerogative and a duty to call upon its allies to function properly and promptly in this regard.

[1] Abstract of an address by the president of the American Society of Engineering Contractors before the St. Louis Convention May 15. At the close of the address the Association voted in favor of the appointment of a committee on a standard form of contract and bond.

This subject is no new field of endeavor for an organization such as the American Water Works Association, for a number of technical organizations have prepared similar documents in recent years. The American Institute of Architects in conjunction with the National Association of Builders' Exchanges and others has compiled splendid forms which have now reached their third edition and are universally used by members of their profession on building work. The American Railway Engineering Association, through a standard committee, has prepared an excellent ready-to-use form for its members. The latter society has achieved an enviable position in this country, for many courts recognize its annual "Manual" and permit its introduction as evidence in establishing maintenance-of-way standards.

The publications of these two societies are standards in their respective branches, not mythologies but standards in the sense that they are the products of their ablest members working together for the best results; yet subject to occasional revision and betterment as experience in their use shows this to be desirable.

Is the public to be blamed for becoming impatient at excessive costs, running unquestionably into hundreds of thousands of dollars annually, due to questionable terminology? Are contractors wholly to blame for being suspicious of motives for the insertion of special clauses and one-sided paragraphs? Are not bonding companies raising rates on account of unnecessary penalty clauses and long-time guarantees? The banks charge more interest on retained percentages than city treasurers get; and payments for special materials delivered long before incorporation in the work will make liens infrequent and prevent delays. Flexible methods of payment have been known to dispel disagreeable receiverships and arbitration clauses are merely expressions of human justice to eliminate interminable court proceedings.

The speaker is not here to propose any favorite terms, to nurse pet hobbies for inclusion in any special contract forms or to propound any exclusive theorems for elucidation. He desires merely to have water works officials feel that contractors are just as keenly alive to their obligations and responsibilities as he knows the officials are to theirs. Contractors have not been beyond reproach, and occasionally even worse, but they realize fully that through the influence of their members collected into a society their tendencies are for improvement and they have a sincere desire to coöperate.

The American Society of Engineering Contractors upholds strict measures which make for quality of construction, it invites the proper placing of responsibility, and it urges encouragement and recognition of good construction service. It admits that contractors are human beings with human ambitions, but it believes reliability is more worthy than cupidity. Contractors remain in their calling because they enjoy its rewards, labors and sorrows better than those of other fields of endeavor and because they hope their work is a genuine service to mankind.

LEAD PIPE COUPLINGS[1]

By J. A. Jensen

The object of this paper is to discuss the joints commonly used in service pipe connections and the development that has taken place from time to time under the guiding light of experience, for the purpose of improvement and prolonging the life of the service and its various appurtenances.

A service pipe, as discussed here, consists of a corporation cock at the water main, a run of lead pipe to the curb or walk, where a stop cock is placed and covered with a box extending to the surface of the ground, and galvanized iron pipe continued to the premises. Lead pipe is selected because of its durability and necessary physical properties for conditions generally met with in most localities. Galvanized iron pipe is suitable for the remaining portion of the run from the stop cock to the building. The cocks are made of bronze or non-corrodible metal for the purpose of resisting deterioration and, as a consequence, to permit ease of operation.

The principal object in the selection of materials and fittings is to make up a suitable and durable structure that will insure the owner minimum repairs and troubles from leakage. Aside from corrosion of materials, consideration should be given to the various kinds of joints used for connecting the several parts of the service pipe.

The use of lead pipe probably originated the so-called "wiped joint" or soldered connection to the cocks. There were originally in use the fixed soldering nipples. These later gave way, for obvious reasons, to the separate nipples and tail pieces, with their necessary couplings, all of which are now commonly used. For the iron pipe, the common threaded fittings are convenient and apparently suitable for all purposes.

Any improvement in the various parts of a service pipe is naturally based upon the troubles arising from leakage. The leak is the alarm that calls attention to the condition of the service. These leaks require considerable attention by water departments to locate

[1] Read before the St. Louis Convention, May 16, 1918.

the trouble, to serve notice upon the owner and to see that prompt repairs are made.

For some time the City of Minneapolis has given consideration to the matter of service leaks that occur between the water main and the meter. During 1917, there were 642 cases of such trouble which were repaired by licensed plumbers under the supervision of the water department. These leaks not only give trouble and expense to the owner, but also cause a considerable loss of water to the municipality. This loss has been variously estimated at from 15,000,000 to 20,000,000 gallons per year. These services are owned by the consumers but the city supervises their maintenance to prevent loss of water.

The number of leaks referred to is an increase of 19 per cent over the previous year. With an increasing number of services approaching the age of trouble and replacement, further increase in the number of leaks must be expected.

There are no practicable means for the reduction of leaks occurring in existing services, but in order to prolong the life and lessen troubles on services that will be installed in the future, a study was made to discover the precise nature of existing troubles so that the proper remedy could be applied.

At present the service connections are made up of a corporation cock at the main, tail piece with wiped joint to lead pipe leading to the stop cock at the curb where it is again wiped to a soldering nipple. From this point to the meter, galvanized iron pipe is used. All of the wiped joints are made by licensed plumbers who install all services under city inspection.

A classification of service leaks was made and some interesting data have been obtained which indicate clearly the various kinds of trouble encountered. The classification was as follows:

1.	Defective curb cock	6	1.0 per cent.
2.	Iron pipe, corroded	302	47.0 per cent.
3.	Lead pipe, corroded or burst	96	15.0 per cent.
4.	Wiped lead joints	238	37.0 per cent.
	Total	642	100.0 per cent.

In considering only the serious leaks in this table, those that occur in iron pipe might be set aside, since such pipes are accessible for repairs without disturbing walks or pavements to any serious

extent. The portion of the service that should be most secure and durable is the lead pipe and its connections which are located under the roadway and in the majority of cases under pavements.

The street leaks may then be separated and reclassified as follows:

1.	Defective curb cock	6	2.0 per cent.
2.	Lead pipe, corroded or burst	96	28.0 per cent.
3.	Wiped lead joints	238	70.0 per cent.
	Total	340	100.0 per cent.

An examination of these street leaks shows the following facts to be apparent:

1. The curb cocks enumerated were found to be defective. They were all old-style cocks which have since been replaced by an improved type by the use of which a minimum amount of trouble will be experienced in the future.

2. The table shows 28 per cent of street leaks to be in the lead pipe itself. About one-sixth of these were due to bursts by swelling of the pipe from repeated water hammer caused by defective faucets. Inspection of these showed all such pipe to be of lighter weight than that used at present. One-fourth of the lead pipe troubles were found under car tracks and the pitting and corrosion clearly indicate electrolysis. The remaining leaks were due to other causes, though many of them also appear to be from the effects of electrolytic action. Since heavy lead pipe is now used and means are employed to eliminate electrolysis, these troubles are already reduced to a minimum, so far as the future is concerned, and justification found for the continued use of lead pipe.

3. The wiped joint leaks make up 70 per cent of the street leaks and troubles. These leaks are due chiefly to inferior workmanship. In most cases there has been failure to secure proper bonding in the joint. A number were "lop-sided;" others barely covered the end of the tail piece and in several cases the solder had run inside and partially closed the water opening. One joint had an opening left no larger than a pencil and after a remarkable record of patience covering a period of 24 years, the owner had the service dug up and the trouble was discovered and corrected. Many of these joints stood up for many years before giving way.

Several years ago lead pipe was used extensively in all plumbing work, but at the present day it has been replaced almost entirely

by improved plumbing appliances and fittings made of other materials than lead, so that the art of wiping lead joints has passed into the hands of pipe fitters rather than the plumbers of former days. In many shops the wiped joints on service pipes form the only work of this nature that is encountered, and it must be undertaken as a special task. The work is attempted by unqualified and incompetent persons not familiar with nor skilled in the art. The result is that present-day wiped joints, under these conditions, do not measure up to the standard of former times, and more trouble may be expected in the future than in the past if such joints continue to be installed.

It appears from a consideration of this matter that these facts have been recognized in various cities. Efforts to secure protection against inferior joints have resulted in the development of a connection that is superior to the wiped joint.

This joint is a mechanical connection in the form of a coupling in which the lead pipe is shaped to form its own gasket. The lead flange should undergo slight reaming to make true parallel surfaces for close contact. The couplings should have plane faces, at least in part, to insure a good joint and must not be permitted to cut the lead flange. The coupling should have a sleeve to cover a short portion of the lead pipe close up to the flange to prevent any movement or deformation of the lead at the joint. The shaping of the lead flange may be conical or at right angles to the axis of the pipe.

There are several types of this joint on the market, all having desirable features of design, but the principle is similar in all cases. The coupling is made a part of the corporation or curb cock and is of composition metal. The joint develops the full strength of the lead pipe and is equally as strong as the best wiped joint and superior to it in results because it can eliminate defective workmanship.

Tests made in the presence of waterworks men have demonstrated conclusively that rupturing stresses applied as internal pressures and tension on lead pipe secured at both ends by flanged curb cocks, have failed to break the joint or injure the coupling. In all cases the lead pipe burst or parted.

The initial cost of the material for this joint is slightly greater than for the wiped joint, but when the necessary labor is added, this cost is more than offset. The cost to the property owner ought at least to be practically the same. An intelligent man can make a

flange coupling joint with simple tools and a pair of wrenches in a very short time, and on the ground where required. The need of a plumber with a blow-pot and other appliances is eliminated.

The comparative cost of the wiped joints and flange couplings in an ordinary service, at recent prices and labor costs, is as follows:

⅝-inch wiped joint corporation cock	$1.05
¾ inch wiped joint curb cock	2.40
2 pounds solder, two wiped joints	.80
Plumber's time, 1 hour	.90
Total cost wiped joints	$5.15
⅝-inch flange coupling corporation cock	$1.30
¾-inch flange coupling curb cock	3.15
Time making joints, 1 hour	.40
Total cost flange joints	4.85

This shows a balance of $0.30 on each service in favor of the flanged joints which can be considered as a margin for fluctuation in cost of materials and labor.

In considering the data given, the use of lead flange joints promises longer life to service connections as a whole, and a consequent reduction of leakage troubles and expense to both the city and property owner.

The street service department of Minneapolis has used lead flange couplings of different types for repair work for several years and they have been satisfactory and successful in every way. They have not only proved more convenient than the wiped joint for the department, but their use has also resulted in the saving of time and money in every case.

OFFICE RECORDS OF THE ST. LOUIS WATER DIVISION, DISTRIBUTION SECTION[1]

By Thomas E. Flaherty

This paper will give a brief description of the organization for the planning, direction, and execution of the work of the distribution section of the St. Louis water department, and a somewhat fuller description of the recording of the work by clerks and draftsmen and of the methods of making corrections and additions and of supplying missing information.

The personnel of the force comprises an engineer-in-charge, assistant engineers, superintendents of construction, labor, stables and vehicles, meters, inspection; a chief draftsman, chief clerk, and the draftsmen, clerks, stenographers and helpers working under these men.

For distribution purposes, the city is divided into six districts, each having a station building, with a station foreman in charge. The most central of these stations is used as the construction superintendent's headquarters, and is known as the "main distribution office," from which all orders emanate, and to which all reports are sent. Another station, known as the "pipe yards," is used as a supply depot and meter testing station. Each district is divided into sections, in charge of section men reporting to the station foreman.

All material is tested before being used; the pipe, valves, hydrants, special castings, and fittings are tested at the place of manufacture, and all other material at the City Testing Laboratory. The test records are kept at the main office in the City Hall. Pipe for contract work is delivered by railroad to depots in different parts of the city, convenient to the work. All other material is stored at the pipe yards and delivered as needed. Records are kept at the pipe yards showing in detail the exact stock on hand at all times.

On receipt of petitions for water mains from proprtye holders on certain streets, or upon notice from the Street Division that certain

[1] Read before the St. Louis Convention, May 16, 1918.

streets (without water mains) are to be paved, or when new mains appear to be needed for distribution purposes, record cards are made out, showing the names and extent of the streets. An inspector then ascertains the number and story-heights of all houses on the street, and the kind of pavement, if paved. An engineer then determines the size and length of pipe, number of fire hydrants, valves and special castings needed; estimates the cost of material and labor and total cost, and tabulates these items on the card. The engineer-in-charge will then place on the card a check mark in such a way as to show at a glance whether the work is recommended or not recommended. In a somewhat similar way various requests for additional fire or sprinkling hydrants, private connections, fire lines, etc., are received, considered, and either recommended or not recommended. These records are then filed for future reference.

All contract work recommended must be approved by the Board of Public Service and contracts awarded for the work. A record is kept, year by year, of all bids received, and the supply clerk keeps a card index of the current prices of all material used by the Water Division. On pipe lines, lowerings, etc., the engineers make plans and profiles of the work, stake out the line and enter their notes in the customary engineer's field book. The plan and profiles and a copy of the engineer's notes are then given to the contractor, or in case of work to be done by the Distribution Section, to the Superintendent of Construction, with instructions to lay the pipe, castings, etc. On small jobs simple instructions are issued to do the work, accompanied when necessary by sketches and memoranda giving all necessary data. On the larger jobs regular pipelaying inspectors are assigned. On the smaller jobs, the station foremen act as inspectors. Longer jobs (not contracts), pipe laying, and pipe lowering are done by pipe-laying foremen in charge of what are known as "floating gangs." These men work in all sections of the city, reporting to the Superintendent of Construction at the main office.

The pipe-laying inspectors keep a daily record of labor and material used, and obtain and record measured locations of all pipe, hydrants, valves and special castings, etc. This record is known as the "inspector's notes." On the smaller jobs and routine work the section men fill out a "daily report sheet," ruled in three columns, viz: "Name," "Time," "Work done and material used." The station foremen obtain and record the measured locations,

which, with the "daily report," are collected by the Superintendent of Construction and brought to the main distribution office. Here, under the direction of the Chief Clerk, a stenographer types these memoranda into sheets known as distribution notes, if the work is done for the city, and "private connection notes," if done for private parties.

At the end of each month the chief clerk forwards to the chief draftsman a "recapitulation sheet" of all "distribution notes" and "private connection notes" sent down from the main office. This list is checked against the chief draftsman's "posting record," and must agree with it, so that no notes can be lost in transit between offices. The engineer's notes, profiles, distribution notes, and private connection notes are now turned over to the chief draftsman, who numbers the notes serially, and enters them in a "posting book," and is then responsible for the correct platting and recording of the work done on all the drafting room records, and of indexing and filing these records, so that they will be instantly available when needed.

The regular drawings of hydrants, special castings, valves, tools, buildings, etc., are filed in a vertical steel plan file, and indexed in the usual way. Profiles and foreign drawings are rolled up and filed serially in numbered tubes in metal pigeon-hole cases, and card-indexed according to subject matter.

The draftsmen may then post the maps and other records in the following order:

First Posting.—This is done on the distribution map. This is a map of the entire city, on a scale of 1320 feet to the inch, on which high-pressure mains are shown in blue and low-pressure mains in red. The size of the pipe is accurately indicated by the thickness of the line; $\frac{1}{5}$ inch indicates 48-inch pipe, $\frac{1}{6}$ inch 36-inch pipe, $\frac{1}{8}$ inch 30-inch pipe, $\frac{1}{16}$ inch 20-inch pipe, $\frac{1}{20}$ inch 15-inch pipe, $\frac{1}{32}$ inch 12-inch pipe, $\frac{1}{40}$ inch 10-inch pipe, $\frac{1}{64}$ inch 8-inch pipe, a single thin line 6-inch pipe, and a single thin dotted line 3-inch or 4-inch pipe. No hydrants, valves, or special castings, except the separating valves between high and low pressure, are shown on this map. On all other records the size of the pipe and nature of the special castings, etc., are shown by the conventional signs or symbols. Thus three lines close together, two of them dotted, enclosing a central full line, indicate 48-inch pipe; two full lines enclosing a central dotted line, 36-inch pipe ;three full lines 30-inch pipe; one

full line and one dotted line, 20-inch pipe; two full lines, 15-inch pipe; two dashed lines, 12-inch pipe; single dashed line, 10-inch pipe; single dot and dash line, 8-inch pipe; single full line, 6-inch pipe; single dotted line, 3-inch or 4-inch pipe, the size being written on the line if necessary. Conventional signs are used for different types of valves, hydrants, and other accessories.

Second posting; section maps. These maps are on a scale of 200 feet to one inch, only nineteen being required for the entire city. About 125 city blocks appear on each section map. Cloth blue prints of these maps, mounted on map rollers, are kept at the various stations. These maps are invaluable, especially to the "night station foreman." The numbered separation valves are shown on these maps as well as all other valves, special castings, hydrants, etc. If a water main of any size should burst or a joyrider break off a hydrant and a flood threaten any locality, the foreman refers to the map of the scene of the accident and orders his gang to close the proper valves until repairs are made.

Third posting; loose-leaf plat book. These plats are on a scale of 100 feet to the inch, 278 of them being required for the entire city. About thirty city blocks are shown on each plat. On these plats a given city area occupies four times the space it occupies on the section map, and of course shows the pipe, hydrants, valves and other specials far more clearly and distinctly. These plats are consulted on all occasions where exact measured distances, pressures, grades, etc., are not required.

Fourth posting; street intersection cards. These are on a scale of 50 feet to the inch, over 6000 being required for the entire city. These cards, when completed, show on one-half of the card, the building and curb lines of all street intersections, and measured locations of all water mains, valves, hydrants, etc., within a radius of one-half the distance from the given street intersection to the next nearest street intersection along any street. On the other half of the card are listed references pertaining to the water main, i. e., the engineer's book and page, inspector's book and page, profile number, date of laying, pressure in pipes, and grade of street intersection at center lines of street. On the back of the card appears the name of the street, under which the card is classified and alphabetically filed, and on the front the name of the intersecting street. A serial number on the back indicates the place of the particular card in the "run" under which it is indexed. A trans-

parent envelope protects the card from soiling or blurring. These cards are in daily use, answering the thousand and one queries received from the public or from other city departments, where exact and specific information is required.

Fifth posting; separation cards. These are made for all intersections at the boundaries of high and low districts, and differ from the street intersection cards only in that the high pressure mains are shown in blue, and low pressure mains are shown in red, and the numbered separation valves are shown.

Sixth posting; sprinkling hydrants. A very complete and accurate list of sprinkling hydrants is kept. This list shows the number of "Sprinkling Districts," 42 in number, in the city, showing the number and location of the hydrants in each district, the total number which on January 1st, 1918 was 1894 hydrants.

All additions or removals during the previous year, and deductions to be made on account of oiled streets, and the amount due by sprinkling contractors for the use of the hydrants, are also accurately shown. In addition to this list, all hydrants are shown on a complete city map, scale 1320 feet to the inch, divided into sprinkling districts. Each hydrant is numbered, the number appearing on the map adjacent to the hydrant. Enlarged maps of each section on scales varying from 200 to 600 feet to the inch, are also kept so that the distances between hydrants can be scaled at any time.

Seventh posting; drinking fountains. All fountains are shown on a complete city map, scale 1320 feet to the inch. The character of the fountains is designated by conventional symbols for the various fountains installed by the city, by humane societies, saloons, etc., these fountains being for horses and in some instances for dogs or other small animals. Special symbols also indicate special ordinance fountains, metered fountains, or the new type known as "bubbling" fountains, from which citizens may drink when thirsty without danger of contamination. A numerical "District Book" of fountains and an alphabetical card index giving exact location, ownership, date of installation, memoranda relative to the maintenance and care and condition of the fountains, date of withdrawal, etc., are also kept.

Eighth posting; pressure records. Pressure gauges are maintained at six carefully selected points in the city, and the charts from them are collected and filed daily, thus keeping, as it were, a finger on the

"Water Pulse" of the city. In addition, numerous special gauge-readings have been taken at a number of well chosen points, at various grades, and platted on a city map, scale 2000 feet to the inch. By making allowance for differences in grades, we have computed reliable maximum, minimum, and average pressures, for practically the entire city. These pressures are recorded on the "Street Intersection Cards."

Ninth posting; pitometer records. A large number of pitometer readings have been taken at points selected with a view toward determining the direction and volume of the flow, by night or day, from the pump mains into the feed mains, and thence into the distribution mains to the consumer. These readings are recorded on a complete city map, scale 800 feet to the inch. On this map are drawn three sets of concentric circles, at one-mile intervals, covering the entire city. The center of one set of these circles is at the Baden High Pressure Pumping Station, one at the Bissell's Point Low Pressure Pumping Station, and one at the Compton Hill Reservoir.

These are the principal records to be posted; and as each record is posted, the draftsman marks on the inspector's or distribution note an abbreviation of the name of the record, as "D" for distribution map; "SP" for sprinkling map, etc. When the notations on the note show that all records have been posted, the chief draftsman OKs the note, and it is then pasted in a numbered "Gummed Stub" book. As the sheets are pasted in, they are paged serially, and index cards made up alphabetically, by street names.

In all municipalities, inherited records are more or less faulty and incomplete, owing in a large measure to continual changes in administration, poor systems in the past, the personal or human equation of the employes, or in some instances, as in that of our own city of St. Louis, to a fire at the City Hall some years ago, which destroyed a number of records. It is frequently found that measured locations are either altogether missing, doubtful, or evidently incorrect. To remedy this condition as far as possible, two methods were used with great success by the present administration, in the St. Louis Water Division:

1. Copies of the section maps previously referred to were laid out on a table at the main office of the Distribution System. The section foremen were then called in, one after another, and, with the chief draftsman, went over the maps carefully and minutely.

Where the section man recognized an error, or was in doubt as to any point, notes were made of the error or doubtful condition, and the corrections made when correct information was obtained, by inspectors delegated to this work. A very large number of important corrections were made in this manner.

2. In the drafting room a set of cards known as "Information Cards" (known among the draftsmen and engineers as "I. C." cards), are kept, and on them are entered requests for information on any doubtful point, for corrected locations, or for missing locations which develop in the course of the day's work. On each card is marked the number of the section, from which the information desired is to be obtained; and on the back of the card is marked the name of the street under which the card is classified. On the face of the card is marked the intersecting street, very much as in the case of the street intersection card. The cards are then grouped by sections, the streets being alphabetically arranged in their group. It is then a comparatively easy matter to send out inspectors to obtain the necessary information or obtain it direct from the section man in charge of the section.

By use of these two systems the faulty or missing information cases have been reduced to a minimum, and the value of the record system has been rendered nearly 100 per cent, in the present distribution system.

REINFORCED CONCRETE PRESSURE PIPE[1]

By Coleman Meriwether

Although concrete was used as along ago as 2300 years to build an aqueduct for the city of Carthage and later for the construction of aqueducts for Rome, it is only recently that pre-cast reinforced concrete pipe has been developed to meet the principal requirements of pressure lines. Experienced gained lately shows that concrete properly made and sufficiently reinforced will resist safely internal and external stresses up to 100 pounds per square inch. Correct methods of manufacture will produce pipe with a low coefficient of friction, experience having shown that a greater discharge was obtained from concrete lines than was anticipated. Leakage through the walls of pre-cast pipe has been almost nil and leakage through the joints has been less than is usually allowable for water mains.

As the construction of pipe lines is usually carried on at temperatures higher than that of the water which will flow through the conduits, it necessarily follows that contraction will occur. This will produce cracks at the joints through which considerable leakage will occur if provision has not been made to care for the contraction.

It may be assumed that the maximum temperature at the time of construction will be near 100° F. and that during the winter in some parts of North America the temperature will drop as low as 50° or more below zero. Pipe lines should be covered with the earth backfill before work is suspended for the winter and all openings in the pipe line should be tightly closed to prevent circulation of air in the conduit. With such precautions the temperature of the pipe line is not likely to drop below 40° F. Flowing water will have a temperature very little under 32° F. The above assumptions will give an idea of the range of temperatures and the consequent contraction and expansion in water conduits.

[1] Read before the Illinois Section, April 16, 1918.

One of the joints now used, figure 1, is constructed with a crimped copper band which is continuous throughout the circumference of the joint. As the pipe contracts the crimp opens and as the pipe expands the crimp closes. This joint is used in pipes 36 to 108 inches in diameter and is a true expansion joint, having been found successful in different parts of North America. To reduce the number of joints it is well to make the pipes as long as is practicable and trench conditions such as bracing, etc., may be limiting factors. The practice so far has been to make pre-cast units of a maximum laying length of 8 feet. It has also been determined in practice that it is necessary to equip each pre-cast unit with the copper expansion joint.

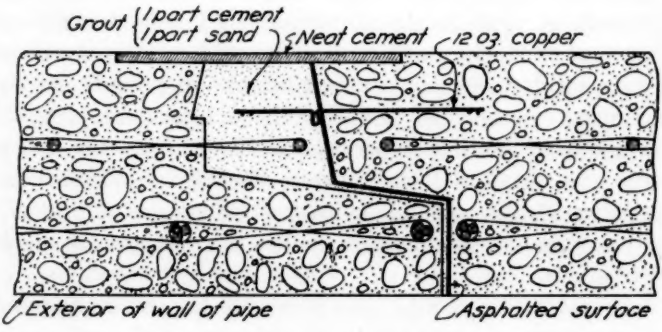


FIG. 1. EXPANSION JOINT.

The installation of a plant for manufacturing 66-inch reinforced concrete pressure pipe for 10 miles of the Greater Winnipeg water conduit in Manitoba, Canada, and some of the details of manufacture are described below. The layout of such a plant is a matter of no small importance, for incessant care must be used in all the details from the installation of the plant and its equipment until the last pipe is laid and the line tested.

Pipe are cast on end and the molds of sheet steel and cast iron must be erected on substantial foundations of reinforced concrete, the surface of the foundations being truly level and finished smoothly so that when the cast iron base mold is set and the sheet steel casings are erected the casings will be truly vertical.

The process of assembling consists, first, of cleaning, oiling and setting the cast iron bases on the concrete foundations. Second, the inner sheet steel casings are set on the bases and on top of them

is placed a steel filling platform used to center and hold truly circular the inner casings as well as to receive concrete from the conveying buckets. Third, the inner cage of reinforcement is placed, with its bottom strand set in an annular slot in the cast iron base; the slot is then filled with dry sand which forms a core and prevents concrete flowing into the space and thereby binding the base to the pipe. Fourth, the outer cage of reinforcement is set and the outer steel casing placed and clamped. The mold is then ready to receive concrete.

A batch of neat cement grout is dumped on the filling platform and flows into the mold, splashing over the two rings of reinforcement in its descent to the bottom of the mold. There a portion of the grout remains until the first batch of concrete is deposited, when this surplus grout rises with and is incorporated into the concrete and thereby replaces any grout which may have been abstracted from the concrete by the reinforcement. This is necessary to secure a pipe dense throughout its mass. The first batch of concrete is dumped on the filling platform almost as soon as the last of the grout flows into the mold, and each mold is filled very quickly, not enough time elapsing to cause any line of separation between batches. The filling is continuous from start to finish. All parts of the molds are cleaned and oiled between each filling.

In the manufacture of most pre-cast concrete pressure pipe it is necessary to use 1 volume of portland cement, $1\frac{1}{2}$ volumes of sand and $2\frac{1}{2}$ volumes of coarse aggregate; this means that $2\frac{1}{2}$ barrels or 950 pounds of cement is used per cubic yard of concrete. In the manufacture of pre-cast pipe for the Winnipeg Aqueduct it was found necessary to use but one sack of cement to 3.8 cubic feet of mixed aggregate, or approximately 2 barrels or 700 pounds of cement per cubic yard of concrete. (The Canadian barrel weighs 350 pounds gross or 346 pounds net.) This small quantity of cement was found sufficient because of the very excellent grading of the mixed aggregate. The concrete is mixed to a quaking or jellylike consistency, which will easily flow into place when slightly puddled.

On the Winnipeg work, the concrete was mixed in batch mixers at each end of the manufacturing plant, and after being dumped into conical buckets was transported by traveling derricks to the molds. A simple ball valve easily and accurately controlled the flow of concrete from the buckets, which carried grout, concrete and

mortar equally well. Molds were filled simultaneously in pairs, one member of each pair being on opposite sides of the derrick track, which was located in the center of the manufacturing site.

When the concrete in the molds reached the top of the outer casing, a cast iron spigot ring was set and the spigot mortar deposited, tamped in place and the copper expansion joint set.

The mortar for spigots on this contract is made of 1 part cement to 2 parts sand. It is mixed to the same consistency as the concrete so as to obtain the same rate of setting and settlement, as nearly as possible. As the spigot mortar settles, more mortar is added until the settlement ceases, when the joint is finished.

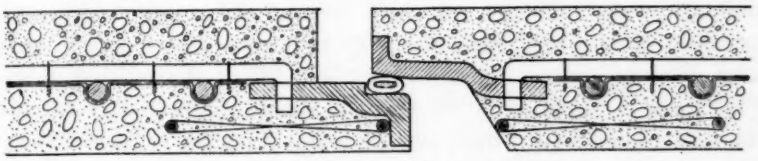
Each expansion joint is mounted on a steel spider which remains in position until the concrete has set and the forms are to be stripped from the pipe. The spider is centered accurately by means of a pin and a hole in the center of the filling platform.

To maintain a constant and uniform rate of setting in the concrete, as well as to protect the concrete from the low night temperatures sometimes attained in Canada, wet steam was used in order to obtain a moist, warm atmosphere about the pipes. The steam mains were laid underground in a way to prevent excessive radiation as well as to place them out of the way. A riser connected each steaming set of five vertical jets with the mains. One of the jets was placed in the center of the concrete foundation so as to be in the center of the cast iron base and the other four jets were spaced equidistant around the circumference of the base, sufficient space being allowed for clearance between the jets and the edge of the base. To confine the steam to the pipes, canvas jackets and hoods were used, the jackets being suspended by hooks from an iron pipe ring supported on two hard wood arms which were raised above the copper expansion joint strip by hard wood blocks on each end of the arms. The jackets were laced vertically and a canvas hood placed over the top of the steam cover spider, the wood arms and the iron ring of the spider preventing the hood from resting on the light copper expansion joint. The hood was tied to the jacket by means of rope and rings, and the jackets were held snugly in place by rope run through eye-bolts secured in the concrete bases. The canvas steam covers were removed with the spider when the forms were stripped, and were replaced as soon as the casings had been removed. The steam was again turned on and the pipe steamed for three to four days.

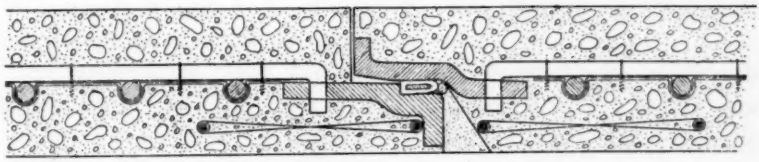
Leakage tests on completed pressure conduits

LOCATION	DIAMETER	LENGTH OF LINE	PRESSURE HEAD	LEAKAGE	
				Per 1000	Per mile
	inches	*feet*	*feet*	*gallons*	*gallons*
Baltimore, Md	108 and 84	8,700	82	1,494	7,888
Dallas, Tex	36	14,000	70	121	639
Ft. Worth, Tex	36 and 48	1,200 12,800	70	1,143	6,035
Seattle,* Wash	42	8,000	135		

*The pipe line in Seattle was a trunk water conduit to operate under a head of 90 feet and every pipe was tested to 135 pounds pressure. Tests were made on short sections of completed line and the leakage was nil.



Position of gasket and pipe ends just before placing pipe together



Finished Joint

FIG. 2. NEW TYPE OF JOINT.

All that has been said heretofore refers particularly to the copper expansion joint type of reinforced concrete pressure pipe. There has recently been developed a new type of expansion joint, and at the time of writing this paper reinforced concrete pressure pipe 36 inches in diameter with this type of joint has been manufactured and tested with satisfactory results.

It is proposed to construct reinforced concrete pressure pipe 10 to 48 inches in diameter and 12 feet long, each section being provided with a cast iron spigot ring at one end and a cast iron bell ring at the other, the rings being cast integrally with the concrete. Figure 2 shows the joint. The faces of the rings which bear upon

the lead gasket will be accurately machined, providing a very true circular surface. The spigot ring is provided with a seat for the lead gasket, the face of which seat forms half of a dovetail, the object being to provide a greater thickness of gasket at the seat of the dovetail. This prevents the gasket being withdrawn when the pipe contracts or when the pipe is deflected.

The lead gasket consists of a lead pipe filled with compressed fiber and then flattened to an elliptical section, the proper length of gasket being turned to a circle, which is joined forming a ring. This ring is placed in the bell and the pipe is then ready to receive the spigot end of the next pipe to be laid. As the pipes are shoved home the lead gasket is changed from the elliptical section to a section which fills the dovetail space and the space between the dovetail of the bell and the outer face of the spigot. After this has been done a light rope of cotton or jute is placed and a weak joint filler of cement mortar is applied, filling the calking space. This space is provided in the event it should be necessary to calk the lead gasket joint. Such calking is not expected to be necessary.

SIGNIFICANCE OF BLACK SANDS IN FILTERS[1]

By J. E. Welker and C. C. Young

Regulations adopted by the Kansas State Board of Health under the Water and Sewage Law passed by the 1915 Legislature require weekly analyses to be made in the laboratory of the board of waters from all surface sources and semi-annual inspections of the water works by the engineers of the division of water and sewage of the board. This relatively close contact with the filter plants has brought up many topics of filter plant operation for discussion and solution, not the least interesting of which is the darkening of the sands.

Filter plant operators noted a gradual darkening of the sands in many of the plants. At first no thought was given to the phenomenon other than the fact that the beds were not clean at the time of observation, but it was found impossible to wash the sand back to its original color. Samples were submitted to the laboratory and analyses made which showed that the dark color was due to manganese and iron. The darker the deposit, the higher the percentage of manganese.

At Osawatomie there was the most striking change in the color of the sand. In a few weeks the color changed from a natural light yellow to coal black. Careful study of the basin and influent lines showed a growth of bryozoa or pipe moss. When these organisms died, the deposit of their sheaths showed a very high percentage of manganese. An analogy was drawn between this phenomenon and the fact that the muck lands of Florida, Hawaii and other places carry an extremely high percentage of manganese and it seemed perfectly plausible that the same principles of decomposition and deposition would be maintained in a filter bed that was allowed to become foul.

In most communities plants are built to supply much more water than is actually needed. Consequently, they are intermittently operated. The filters will be run for a few hours and be allowed to stand six or eight or even twenty-four hours without filtering again and without washing. This procedure is continued until

[1] Read before the St. Louis Convention, May 14, 1918.

such a loss of head results that no more water can be put through the filter. The filter is then washed. In every filter plant mentioned in this paper, there have probably been many periods of stagnation varying from eight to twenty-four hours.

In Meade County, Kansas, and elsewhere there have been found small beds of almost pure quartz sand, coated with a deposit similar to those that develop in intermittently operated filter plants. No

TABLE 1

Results of analyses of filter sands: grams in 10-gram samples

	RATE OF WATER	Mn_3O_4	YEARS IN BED	Fe_2O_3	Mn_3O_4 AND Fe_2O_3	OXIDES AND CLAY	DIFFERENCE, CLAY
Neosho River	*inches*						
Burlington	12	0.0030	4	0.0035	0.0065	0.0771	0.0706
Chanute	15	0.0076	4	0.0142	0.0218	0.3908	0.3690
Humboldt	15	0.0129	2	0.0214	0.0343	0.4594	0.4251
Council Grove		0.0683	3½	0.0071	0.0754	0.3470	0.2716
Verdigris River							
Independence							
Original		0.0007	4	0.0093	0.0100	0.0583	0.0483
Used		0.0070		0.0214	0.0284	0.2915	0.2631
Coffeyville	15.0	0.0172	4½	0.0092	0.0404	0.3169	0.2765
Cherryvale	12.0	0.0312	6	0.0214	0.0526	0.9930	0.9404
Walnut River							
Douglas	12.0	0.0061	3½	0.0017	0.0078	0.1206	0.1128
Winfield	7.5	0.0634	8	0.0214	0.0848	0.6042	0.5194
Augusta	9.0	0.2037	6	0.0178	0.2215	0.9459	0.7244
Marais des Cygnes							
Osawatomie		0.0298	2½	0.0172	0.0470	0.2876	0.2406
Mill Creek							
Washington	12.0	0.0580	3½	0.0071	0.0651	0.2550	0.1899
Impounding Reservoir							
Garnett	18.0	0.0240	3	0.0214	0.0454	0.3507	0.3053
Olathe	14.7	0.0141	3½	0.0050	0.0191	0.1084	0.0893
Shreveport, La		0.0095		0.0214	0.0309	0.2642	0.2333

one can say just how and where these beds were laid down but it is fair to suppose that the conditions were somewhat similar to that existing in a foul filter bed.

In making analyses, the sodium bismuthate method was used to make the determination of manganese and the iron was determined colorimetrically. The clay reported in the table was accreted with the deposit of manganese and iron oxides. It is fortunate that the

laboratory saved samples of the original sands that were introduced into the filter plants at the time of their construction. All of the sands returned negative results for manganese, with the exception of the sample from Independence, which gave 10 milligrams of the combined oxides.

Table 1 gives the results of analyses and a short description of each plant is appended.

Burlington. Installation test made May, 1914. New York Continental Jewell standard filter equipment; combined air and water wash. Wash water from distribution system at pressure of 50 pounds per square inch. Wash water valve opened to give rate of 12 inches vertical rise per minute. Considerable difficulty has been experienced with microscopic growth in basins and filters. General operation of plant good. Sand removed March, 1917, following trouble with filter bed. One manifold pipe found broken.

Chanute. Installation test made May, 1914. Pittsburg Filter Company standard equipment. Washed with water alone, furnished by centrifugal pump, giving a rate of 15 inches vertical rise per minute. Plant operation fair.

Humboldt. Installation test made May, 1916. Pittsburg Filter Company standard equipment. Filters washed with water alone. Wash water supplied from distribution system and valve opened to give wash water rate of 15 inches vertical rise per minute. Plant operation fair.

Council Grove. Installation made September, 1914. New York Continental Jewell Filter Company standard wooden tub filter construction. Filters washed with mechanical agitation. Wash water supplied from distribution system pressure. No reducing valve used on the wash water line and as a result excessive rates have been used, resulting in the displacement of the sand and gravel. In 1916 the filter beds were dug up and the gravel was found to be very much displaced and mixed with the sand, and many of the strainers clogged. February, 1918, the beds were again dug up and approximately 50 per cent of the strainers were found to be clogged. Plant operation good.

Independence. Installation test made May, 1914. Concrete filter construction, with ridged bottom under-drains using wire screen between gravel and sand. Wash water supplied from wash water tank, having a pressure of approximately 22 pounds per square inch at the inlet. Plant operation fair.

Coffeyville. Installation test December, 1913. New York Continental Jewell Filtration Company standard equipment. Combined air and water wash. Wash water supplied by centrifugal pump, giving a wash velocity of approximately 15 inches vertical rise per minute. Plant operation good.

Cherryvale. Installation test June, 1912. New York Continental Jewell Filtration Company standard equipment. Filter washed with combined air and water wash. Wash water supplied by centrifugal pump, giving a wash water velocity of approximately 12 inches vertical rise per minute. Plant operation good.

Douglas. Installation test made September, 1914. New York Continental Jewell Filtration Company standard equipment. Filter washed with com-

bined air and water wash. Water supplied from distribution system at a pressure of approximately 50 pounds per square inch. Variable rate of wash water. Operation of plant good.

Winfield. Plant installed 1910. Modified Greer filter construction, using combined air and water wash. Wash water supplied by separate wash water pump, giving a wash water velocity of 7½ inches vertical rise per minute. Plant operation variable.

Augusta. Installation test July, 1912. American Water Softening Company standard filter equipment. Air and water wash. Wash water originally furnished from distribution system; now furnished by separate wash water pump, which gives a wash water velocity of 9 inches vertical rise per minute. In 1916 the beds washed unevenly and mud balls were in evidence. Plant operation inconstant.

Osawatomie. Installation test December, 1915. New York Continental Jewell Filtration Company standard equipment. Combined air and water wash. Wash water secured from distribution system at 60 to 80 pounds pressure per square inch. On different occasions the wash water valve has been opened so that the wash water rate was excessive and the sand and gravel became mixed. The plant has had considerable operating trouble from microscopic growth in basins and filters. Plant operation variable.

Washington. Installation test October, 1914. New York Continental Jewell Filtration Company standard equipment. Filter washed with combined air and water. Wash water supplied by separate wash water pump, giving a wash water velocity of 12 to 13 inches vertical rise per minute. Plant operation variable.

Garnett. Plant installed 1908. New York Continental Jewell Filtration Company standard equipment. Filters washed with water only. Water supplied directly from distribution system, at a pressure of approximately 60 pounds per square inch at the manifold, giving a wash water velocity of approximately 18 inches vertical rise per minute. Sand replaced in 1915; in a very dirty condition in 1917. Plant operation poor.

Olathe. Installation test August, 1914. Pittsburg Filter Company's equipment. Air and water wash. Wash water velocity 14.7 inches vertical rise per minute. In January, 1918, the filters washed unevenly and several of the strainers were clogged. Operation good.

This investigation has not been carried to a point where it can be definitely stated that the darkening of the sand has any effect upon the efficiency of the filter, but there is a feature well worth investigation along this line because it seems that penetration of the bed is followed by this coloration. At the present time the only definite discovery is an ocular index of improper operation. This is something the small plant filter operator can be warned to look out for. If he finds that his sand is becoming dark, he should change his time or method of washing so that he will have no fouling or penetration of the bed.

MEMORANDA OF OFFICE RECORDS[1]

By A. W. Cuddeback

The office records of the location of service pipes, valves, hydrants and distribution mains of the Passaic Water Company are about as simple as can be devised, consistent with giving the information necessary and useful for the proper recording of such structures.

Service pipes. Service pipes are given a serial number, which is also the number that goes with the account, and these numbers have been running continuously from one up since the business was started. Where there are several services pipes supplying one property which comes under one account, they have the same number.

The accounts are indexed on the ledger cards under the street number and name of the person paying the water rent.

The record of the service is entered on a No. 9518 Library Bureau card, which is practically 3 by 5 inches in size. The front of this card shows the serial number; street number; name; size of tap in main; size of service pipe; size of main; and gives a measurement of the location of the corporation cock, which refers to the lot line, the building or curb line. It has the date on which the connection was made; the kind of material; and the name of the foreman putting it in; whether there is a curb shut-off and how far laid.

The reverse side of this card has printed upon it a diagram of a city block with streets on four sides of it, on which is made a sketch of the property, indicating the building; the main in the street; and the service pipe. On this the reference measurements are entered again, showing to what point they refer. The four streets bounding the block are named so the property can be definitely located.

If the service pipe is renewed at any time, the detail of the renewal is entered upon the card, or if necessary, a new card is made, giving the additional information required by the change.

When a service pipe is abandoned for any reason and is not at that time replaced with another service, the number formerly

[1] Read at the St. Louis Convention, May 16, 1918.

applying to that service is used for some other service, thus avoiding a lot of dead numbers.

It is very easy to get the proper information for entering on this card, because the company lays its own service pipes and has been doing so for the past 20 years. Where private plumbers are allowed to make service pipe connections, proper cards should be furnished them, on which to record the information desired to be kept for reporting to the water office.

For the purpose of recording the location of services not on rectangular blocks, cards are used with the reverse side blank, in order that a sketch showing the exact conditions may be made.

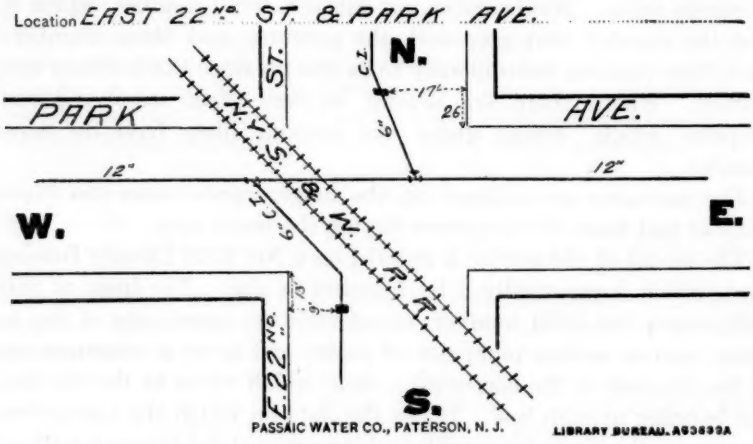


FIG. 1. FRONT OF VALVE RECORD CARD

Valves. Valve cards are exactly the same size as the service pipe cards. The front of the card in this case, however, shows the sketch, which has four blocks with two streets between, figure 1. The pipes are sketched in the streets in both directions. The cardinal points are marked with a rubber stamp. The location of the valve is indicated, and the measurements, referring in almost all cases to the curb, are entered on the sketch. The names of the streets are marked.

The cards are indexed according to streets and run consecutively in one direction on the street. They are cross-indexed by entering a card for the cross street on which is put only the name of the street.

On the reverse side are printed locations for four valves, figure 2. Locations are made by giving the distance north, east, south or west, from the curb lines.

As in the service pipe cards, for special locations, blank cards are provided on which the sketch can be made.

Valves are also given a number, which number is consecutive with their installation.

Hydrants. No special card is used for hydrants. The record of the hydrant is kept in a book, which gives the serial number of the hydrant; the street on which the hydrant is located, the street on which the hydrant faces being mentioned first; the date it was installed; make of the hydrant; and the water pressure; also whether

Size 6" Location EAST 22ND ST. S. OF PARK AVE. No 1852
13 ft — in S from the S Curb of PARK AVE. St.
9 ft — in E from the W Curb of EAST 22ND St.

Size 6" Location EAST 22ND ST. N. OF PARK AVE. No 1853
26 ft — in N from the N Curb of PARK AVE. St.
17 ft — in W from the E Curb of EAST 22ND St.

Size Location No
ft in from the Curb of St.
ft in from the Curb of St.

Size Location No
ft in from the Curb of St.
ft in from the Curb of St.

FIG. 2. REVERSE OF VALVE RECORD CARD.

the hydrant is gated or not. A card index is kept of this book by street intersections so that the book can be readily referred to.

Distribution mains. A field book with pages 5 by $7\frac{1}{2}$ inches is kept of all distribution main installations. This book is of the ordinary size used by engineers for notes, and is ruled in small squares.

The necessary information for this book is sketched in pencil when the installation is made. A complete sketch is made showing the street lines; location of pipe with reference to these lines and proper measurements; location of valves, hydrants, branches and specials is also indicated; dead ends; kind of material used; name of foreman making the installation; character of the digging; depth to which pipe is laid, as shown in Fig. 3.

There also appears on this page a symbol which shows, when checked, that the information given here has been recorded in its proper place, i. e.,

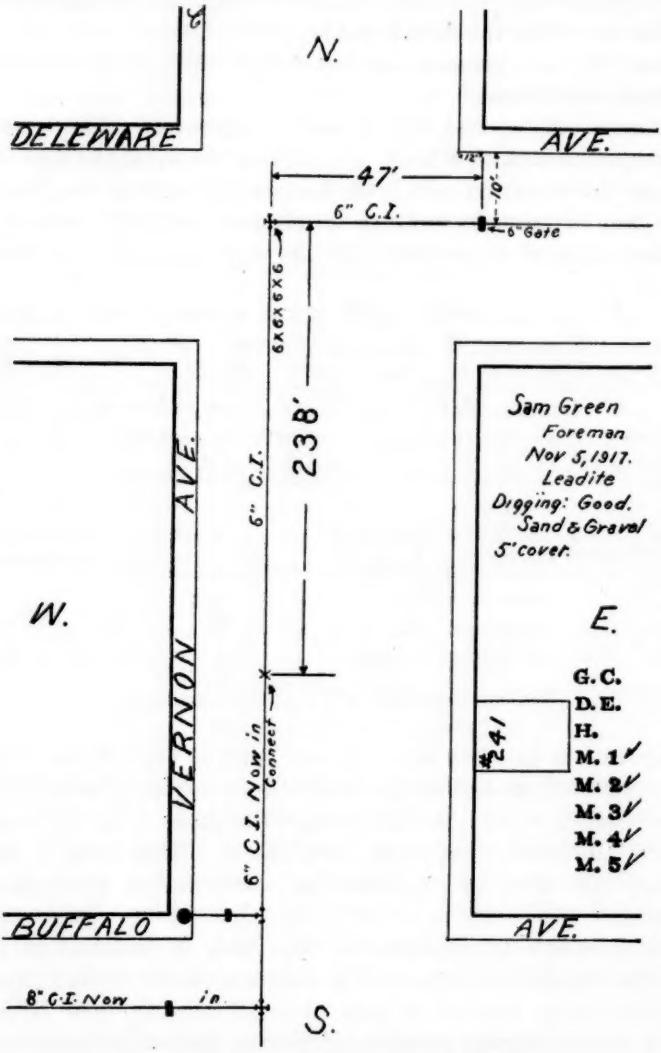


FIG. 3. PAGE FROM DISTRIBUTION FIELD BOOK

G. C. means gate card, and when checked that the information has been placed on the proper card and filed.

D. E. means dead end, that the proper record has been made of the dead end on cards kept for this purpose.

H. means hydrant, and that it has been recorded in the proper hydrant book.

M. 1, M. 2, M. 3, M. 4, and M. 5 indicate that the information on this page has been recorded on Maps 1, 2, 3, 4, and 5. These maps are large maps on a scale of 400 feet to the inch, which show the entire distribution system, with location of hydrants, valves and street mains indicated according to the nomenclature adopted. Maps of this kind are kept in various convenient places for reference, as in the working office and in the office of the superintendent and engineering department.

The book is indexed by streets with reference to the book number and page number on which the original sketch appears, and kept properly filed. No other detail record of main locations is kept. It has been found that all the records necessary or desirable can be kept in this way. As much or as little detail as desired can be entered in this book.

None of the records, either in the books or on cards, is drawn to scale.

Maps showing the distribution system as a whole, are usually made with the width of the streets exaggerated so that the piping system stands out as the main feature on the map. It does not take an expert draftsman to do any of this work. Anybody who is a fairly good letterer and can use a straight line pen and is neat, can do the work satisfactorily.

WATER POLLUTION AND FISH LIFE[1]

By Victor E. Shelford

The United States Fish Commission is urging the public to eat fish—to make every day a fish day. This was once the case. In a great strike of apprentices in the early days of the republic one of their chief demands was that they receive salmon only three times a week. The richness of the fish supply of our eastern states in the colonial days and early days of the republic can scarcely be appreciated. One author said of the shad in the Susquehanna and Delaware Rivers:

> They came in such vast multitudes that still waters seemed filled with eddies, while the shallows were beaten into foam by them in their struggles to reach their spawning grounds. They swarmed every spring from mouth to head waters of every stream from Maine to Florida.

Shad was an important food fish in the early days of the nation; they were eaten fresh and smoked, and were salted for winter use. During the spring runs people traveled long distances to shoal waters to obtain their winter's supply. Along the Illinois river many years ago the buffalo fish was the chief marketable species. These were caught by farmers, fishermen and others during the breeding season and shipped by boat, principally to St. Louis. No ice was used. The fish were frequently thrown away because they spoiled or the market was overloaded.

Perhaps without mention of these facts, the author's remarks about fish would not mean very much. Americans have been very careless with the fish resources in this country. There was over-catch. Then pollution of water by wastes from manufacturing plants and by sewage of cities completed the work of destruction already started by heedless fishermen, but the pollution of the water is far more serious than over-fishing because it destroys the

[1] Read before the Illinois Section, April 16, 1918. A more complete discussion of the nine topics mentioned in this paper 20 being published in the Bulletin of the Illinois State Laboratory of Natural History, Vol. xiii; Art. 2.

possibility of easy recovery. It is well to take stock of our knowledge now under pressure of numerous problems demanding immediate solution because of the great war. In connection with the manufacture of munitions, the proposed recovery of grease from sewage, and other activities, some of the most dangerous effluents result, giving us special war problems. The dangers to fishes are increased with the greater need to conserve them. Means of measuring the harm which pollution will cause are needed at once. Our knowledge is incomplete and not organized for the purpose. While it is not difficult to formulate a number of important questions to keep in mind in dealing with water pollution, the answers to most of them demand much investigation. However, the author will outline nine points very important to consider in our efforts to safeguard fishes.

1. First of all, some of the wastes introduced into the sea, lakes and streams kill fish and other animals useful for food. Tests of the toxicity of sewage and industrial wastes must be made. In doing this it is not sufficient that one take any fish or other animal he picks up. A fish that is representatively sensitive must be used. For this purpose use young suckers—either the red horse or common sucker. They are not less resistent than some of the plants and animals which constitute the food of fishes and are sufficiently sensitive to afford a good criterion of danger to fishes in general. Among marine animals either fishes or shrimps may be used.

2. There is always a most sensitive period in the life of a fish or other useful animal. This is usually in the young stages. In the case of the clam worm the egg at the time it is laid is about twenty times more resistant than the young larva. Some fishes appear to be most sensitive at the time of hatching and others in the egg stage; this stage may be a hundred times more sensitive than the adult. The most significant thing to know about poisons is the least fatal concentration to the most sensitive stage. In general one should use the youngest test animals he can get, for example the youngest suckers.

3. Conditions in streams and other bodies of water vary; the concentration of the polluting substance should be known. The minimum flow of a stream usually gives the greatest concentration. The summer low-water conditions are dangerous because of little flow and high temperature which increases toxicity; the winter low-water because of slow flow and ice which prevents aeration.

Perhaps something might be done, such as forcing air through the effluent near the point where the pollution is introduced to reduce this danger during critical periods by increasing oxygen and removing carbon dioxide.

4. The removal of constituents and the results of treatment of various polluting substances must be fully analyzed. It is necessary to know the results of treatment of sewage, industrial wastes, etc., in terms of their effects on useful aquatic animals. If coal tar wastes are partially recovered it is necessary to know whether the residue is still toxic. Experiments have shown that nearly all constituents are, and hence any residue will be almost certain to be poisonous. Effluents which result from the Miles acid process of sewage treatment must receive special consideration, because acid effluents such as result from it are very poisonous, particularly those resulting from the use of SO_2. Such questions as how much acid will the water neutralize, how much CO_2 is liberated, and the like, must be answered. Also which is the more toxic, H_2SO_3 or H_2SO_4? From existing knowledge it appears that sulphites and acid sulphites are far more toxic than sulphates.

5. The substances which are introduced into the water not only affect fishes directly but also act through effects on the bottoms on which eggs rest. Lake Michigan once produced numerous white-fish. The number of whitefish has been greatly reduced. The reasons are not only over-catch but also the covering up of breeding bottoms with a large amount of sawdust and other rubbish which makes the spawning grounds useless. Some of this bottom can never be recovered, at least, not for a long time.

6. The reaction of the animals demands attention. Both fresh water and marine fishes react negatively to acids, i.e., they turn back when they encounter them. Freshwater fishes will not enter any but the weakest concentration; marine pelagic fishes select alkaline water. In the fourteenth century, about the time the Baltic towns of the Hanseatic League, which depended upon the herring industry, were at their most prosperous stage, herring began to leave the locality and are supposed to have migrated to the North Sea. Herring were at one time very abundant in places which are now practically deserted. Herring invariably select a slightly alkaline water and avoid acids which result from contamination. The New Jersey Mosquito Commission finds that the acids thrown into the coast waters by munition works repels the killifishes on which

they depend to keep the mosquitoes down. There is also a different danger from other substances, especially organic compounds, in that fishes swim into solutions of these and after short stays avoid pure water and die.

7. The time it takes a body of water to recover if it has once been depleted must be considered. It has been shown that a whole association of plants and animals must re-develop in places of this sort. If a pine forest is destroyed by fire, fire weeds grow up followed by cottonwoods or birches and after a long time pines again. A similar slow process must take place in depleted waters.

8. There is danger from decisions made without investigation of a particular case. One important reason for this is that poisons are in some cases rendered much less toxic by salts in solution in the water polluted and in other cases they are rendered much more toxic by the salts present.

9. We need a new system of bookkeeping in dealing with these matters. The value of a waste is not simply the value of the products which may be prepared from it after the cost of recovery has been deducted, but from the value must be substracted all damage which the untreated waste does to water supply, fisheries, etc. That is, the needs of the entire community must be considered, and not merely those of a few individuals.

WATER TREATMENT AT COUNCIL GROVE, KANSAS[1]

By Louis L. Tribus

In March, 1915, the Association published a brief paper descriptive of the then recently remodeled water works station at Council Grove, Kansas, the special item of current interest being that portion of the plant treating the raw river water. The feature of novelty lay in the plan for successive application of dissolved coagulant, as the water passed from one part of the system to another. The use of coagulant could be very closely regulated as river conditions required and as the water exhibited its very varying characteristics and behavior while going through the different original stages from sometimes serious foulness to clear and safe potability.

After three years of operation, it may be of interest to note some of the results secured under the peculiar difficulties that have had to be met.

The Neosho River has but a limited watershed; it flows largely over a rocky bed, traversing a black soil belt but sparsely wooded. The general region is subject to sudden and violent storms which are without regularity as to season. These conditions produce high floods and varying turbidities, at times well over 5000 parts per million. How much more than that is not recorded, for the local testing apparatus has no higher range. The river flow varies from almost nothing (a slight spring supply) to an over-abundant maximum, running from 7 to 15 feet in depth over the dam, having a crest length of 100 feet or over.

Alkalinity ranges from a minimum of 48 to a maximum of 365, decreasing as the river rises.

With the silt burden come also varying colloidal troubles.

The water temperature fluctuates from a minimum of 33° to a maximum of 86°.

The bacterial content has naturally a very wide range, due to the nature of the watershed and varying character of the flow of the river.

[1] Read at the St. Louis Convention, May 14, 1918.

Algae are prolific at times in the summer season when the river is low; copper sulphate is used sparingly, but with success, in the lower reservoir. The natural quality of the water at low river stages is quite fair, although high in permanent hardness, which lessens somewhat as storm waters raise the river level.

It can be well imagined that with these characteristics, the treatment problem is one that can not be left to unintelligent handling.

The two successive superintendents of the plant have taken very great personal interest in its operation, endeavoring constantly to not only secure the delivery of an effluent that would be as near perfect as possible, but to reduce costs at the same time.

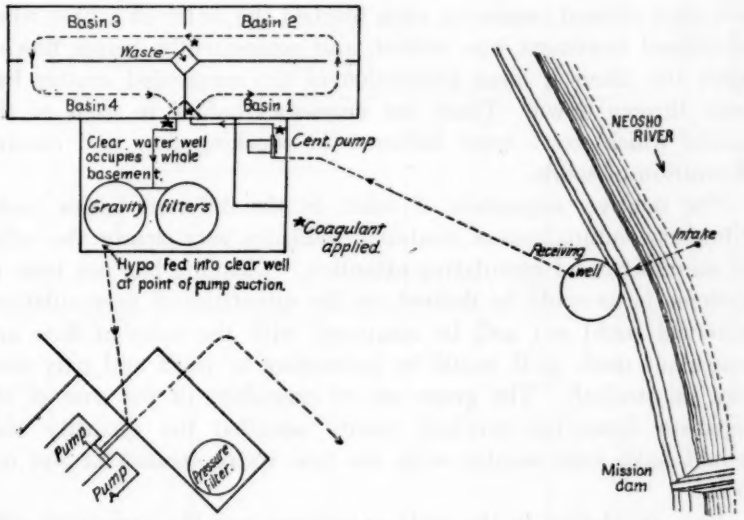


FIG. 1. COURSE OF WATER THROUGH PURIFICATION PLANT

The water flows from the river into a reception well in which considerable deposition of suspended matter takes place. From this a low-lift centrifugal pump raises it to the first of a series of four basins. At the pump it can receive a first dose of liquid sulphate of alumina, which becomes pretty thoroughly mixed in the discharge pipe before entering the first basin near the bottom through a triangular down-chute.

At this point a second dose can be given. The water then passes the length of basin 1 and through a low-level submerged opening

enters basin 2. Passing through this, a third dose can be added just as it reaches basin 3 through a second submerged opening, placed at a higher level than that between basins 1 and 2. Flowing through basin 3 and into basin 4 at a still higher elevation, though still submerged, the water finds, at the farther end, the inlet to the filters, where a fourth dose of coagulant can be added.

It was found in the early stages of experimenting that in a turbid stage of the river the whole charge of coagulant at the pump or at basin 1 alone, was ineffective, for the globules of aluminum hydrate became coated with mud long before full service had been rendered, consequently practically untreated water passed to the filters. If, however, the charge was sub-divided and applied at points as observation showed necessary, each reached the water at a time when additional treatment was needed, and consequently before flowing upon the filters a large proportion of the suspended matter had been thrown down. There are cross-wall baffles in each of the basins which exert some influence in checking flow and causing deposition of solids.

The relative deposition of solids in the different basins under different combinations of treatment indicates very clearly the value of successive and cumulative attention. Cleaning has not been as systematic as could be desired, so the quantities of accumulations removed could not well be compared with the rates of flow and coagulant used, as it would be interesting to learn and may some day be studied. The gross use of coagulant in the sum of the separate doses has nowhere nearly equalled the quantity that would have been needed with the raw water treated at but one point.

Very perplexing in the early operations was the experience with large doses of coagulant. It seemed as if the turbidity would not yield; apparently no floc formed and the filters soon became choked. Then suddenly, action would begin and all would go satisfactorily and the results could thereafter be secured with very much smaller doses.

Temperature and alkalinity changes also exert a decided influence upon the purifying action, though studies have not yet been sufficient to standardize the treatment and reach definite conclusions.

It has been impossible, for financial reasons, to employ a chemist regularly, so that operations, other than those determined by turbidity and alkalinity, have depended upon the operator's judg-

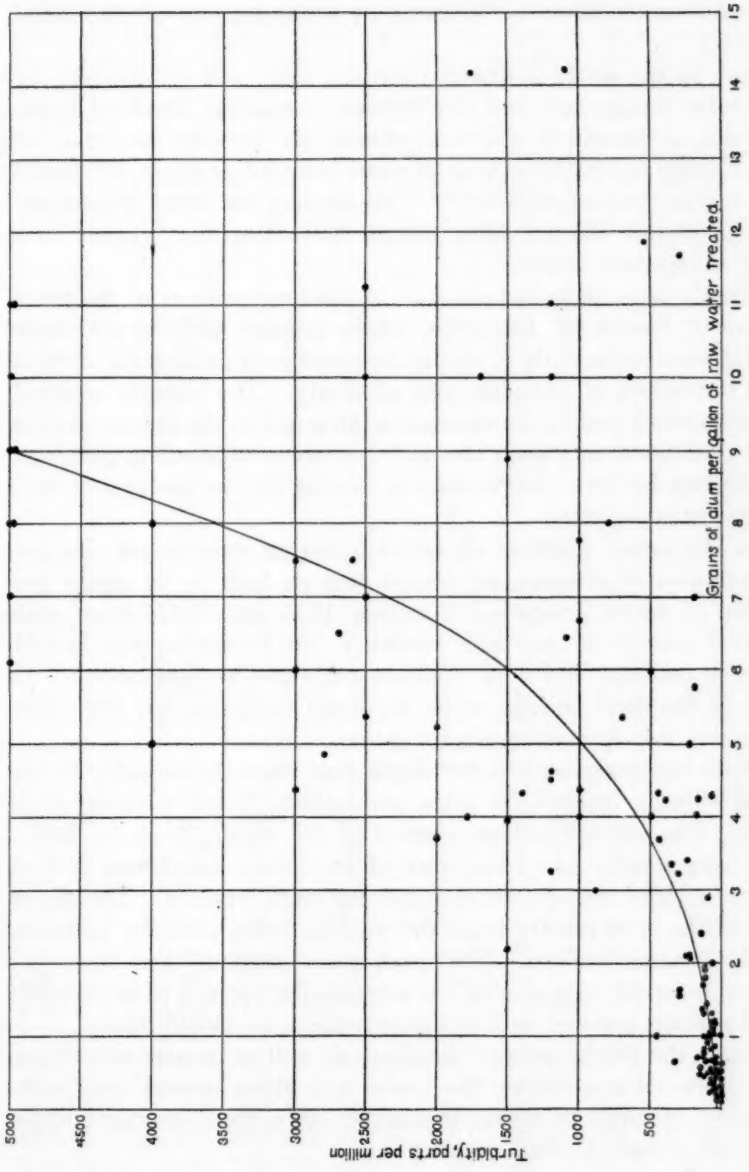


FIG. 2. 150 TYPICAL DAILY READINGS; TURBIDITY AND ALUM

ment, which has been largely controlled by the show of floc in the basins or on the filters and of course by the appearance of the filtered effluent.

Just as the water is drawn from the clear well for delivery by the main pumps into the city system, it receives dissolved hypochlorite, to the extent of 2 to 2½ pounds per day (dry chemical) for the 250,000 to 350,000 gallons of water pumped or about 10 pounds per million gallons ordinarily. This renders the water practically sterile, though the preceding operations remove the bacteria to a very satisfactory degree.

Weekly samples have been sent to the headquarters of the State Board of Health at Lawrence, where regular analyses are made with a view particularly to noting the presence of pathogenic bacteria and the values of turbidity and alkalinity. The reports received following such examination serve as a fair guide to the superintendent and give him a very good idea as to his success in handling the plant, confirming his own observations or causing him to use greater care if danger is indicated.

In the earlier weeks of operation following construction, the use of sulphate of alumina sometimes was as high as 20 grains per gallon of water pumped, but during 1916 and 1917, even with several periods of very high turbidity, the maximum was but 11 on one occasion and 9 on another; otherwise nothing above 7 in any of the flood periods, while the usual total rate has been considerably less than one grain per gallon.

With the exception of a few single days when the turbidity in the final effluent reached 30 parts per million, it has normally been zero. The successive improvement of the water, basin by basin, has very greatly eased the work of the filters, and hence in turn saves a large use of filtered water for back washing. The filters are of the open gravity type, the washing being aided by agitation with rotating stirrers. The wash-water pressure has been too variable for the best results, but a regulating valve is to be installed and perhaps a meter, so that future betterment should follow.

Upon the official tests of the plant, as well as in later operations, the bacterial removal by the basins and filters proved very satisfactory, through as before mentioned, as a final safeguard hypochlorite is used in small quantity.

The State Board of Health began making its tests in July, 1915; out of 102 reports since then received, 85 stated the water to be in

The test required for the filtered water shall be a reduction of bacterial content of at least 98 per cent from the content in the raw water, except that when the total number of bacteria is less than 3500 per cubic centimeter in the raw water, the filtrate must not contain in excess of 75 per cubic centimeter.

TABLE 1

Bacterial reduction in Council Grove treatment plant

DATE OF REPORT	BACTERIA PER CUBIC CENTIMETER		DATE OF REPORT	BACTERIA PER CUBIC CENTIMETER		DATE OF REPORT	BACTERIA PER CUBIC CENTIMETER	
	Raw water	Filtrate		Raw water	Filtrate		Raw water	Filtrate
1915			*1916*			*1917*		
July 22	5,000	750	May 8	5,000	25	Mar. 19	80	45
July 31	3,000	120	May 12	300	60	Mar. 23	120	50
Aug. 5	2,000	50	May 20	1,900	310	Apr. 3	40	20
Aug. 13	1,200	30	June 3	21,000	60	Apr. 9	60	15
Aug. 19	82,000	22	June 16	2,000	60	Apr. 13	50	30
Aug. 30	4,000	100	June 26	6,000	30	Apr. 27	3,710	80
Sept. 4	3,000	75	July 6	600	460	May 7	1,360	20
Sept. 9	460	130	July 14	500	10	May 18	600	11
Sept. 18	450	15	July 20	1,900	70	May 25	450	18
Sept. 27	65,000	16	July 28	300	10	June 7	15,000	65
Oct. 6	92,000	42	Aug. 3	300	150	June 11	10,000	100
Oct. 11	27,000	410	Aug. 19	4,000	1,000	June 21	150	50
Oct. 15	300	25	Aug. 26	1,400	400	June 28	300	5
Oct. 22	70,000	30	Sept. 2	1,400	150	July 10	150	25
Nov. 2	1,900	26	Sept. 9	900	14	July 13	2,500	40
Nov. 8	3,100	64	Sept. 15	2,000	200	July 18	400	10
Nov. 12	1,600	30	Sept. 23	250	15	July 28	600	60
Nov. 22	4,500	25	Sept. 30	1,600	20	Aug. 4	1,500	150
Nov. 29	420	16	Oct. 7	90	15	Aug. 9	1,900	175
Dec. 4	200	15	Oct. 13	150	6	Sept. 5	1,800	8
Dec. 13	400	70	Oct. 20	200	16	Sept. 15	15	1
Dec. 17	1,400	25	Nov. 4	900	35	Oct. 6	750	550
1916			Nov. 11	500	30	Oct. 15	700	5
Jan. 17	3,000	50	Nov. 17	2,000	10	Oct. 20	200	9
Feb. 3	11,000	120	Nov. 24	800	90	Oct. 25	1,900	5
Feb. 11	40,000	35	Dec. 18	630	19	Nov. 3	1,000	8
Feb. 21	4,100	130	*1917*			Nov. 9	650	15
Feb. 26	1,400	25	Jan. 10	3,400	200	Nov. 16	900	125
Mar. 7	6,300	80	Jan. 15	1,400	290	Nov. 24	600	20
Mar. 13	250	100	Jan. 26	180	15	Dec. 3	1,000	50
Mar. 18	900	30	Jan. 28	400	220	Dec. 7	500	40
Mar. 23	1,000,000	840	Feb. 10	80	30	Dec. 27	225	90
Apr. 13	500	50	Feb. 17	70	20	*1918*		
Apr. 17	2,500	120	Feb. 23	150	26	Feb. 1	250	5
Apr. 23	850	225	Mar. 5	90	60	Feb. 14	450	55
May 1	1,500	800	Mar. 12	50	30	Feb. 18	150	15

"excellent," "very good," "good" and "fair" condition. Of the remaining 17, only two condemned the water, the others, though reporting "poor" rather raised question as to details of treatment, as the best results were not being secured. The bacterial count varies very greatly in the raw water and colon bacilli are usually indicated. The Board of Health makes its tests usually of the raw water and the finished effluent as taken from a service tap at the station. The original acceptance test of the filters was made subject to its approval.

The contract paragraph concerning bacterial removal is repeated on page 443, so that it may be compared with the results of the $2\frac{3}{4}$ years succeeding, as reported by the chemists of the Board.

Of the 105 bacterial reports, 81 show results handsomely within the test conditions, and but few of the others indicate any special deficiency in action. At times of heavy turbidity, when bacterial count runs specially high, the operations have been signally efficient; this indicates, perhaps, more special care in operation, due to the difficulty in securing a clear filtrate.

Taken as a whole, therefore, without a resident chemist, with several changes of station engineer and assistant, the breaking in of inexperienced men each time, and during quite a portion of 1917 with a superintendent in ill health, the showing is quite favorable to the working of the plant.

In a few tests which have been made, the percentage of successive betterment through treatment in the basins and the filters has been very interesting, but no consistent regular record has been kept, due to lack of sufficient time of the superintendent or engineer.

The operation of the plant as a whole has abundantly justified its design, and responds effectively to good care; though the filter strainers clog rather more than is desired and may have to be changed in type before long.

The diagrams illustrating this paper, other than figure 1, a plan showing course of the water from river to consumers, are made up from typical daily notations of turbidity, alkalinity and grains per gallon of sulphate of alumina used in the treatment.

From 1100 observations recorded during 1915 to 1917 inclusive, 150 have been selected, regardless of season, so as to cover so far as possible several readings at each rate throughout the whole range of variation.

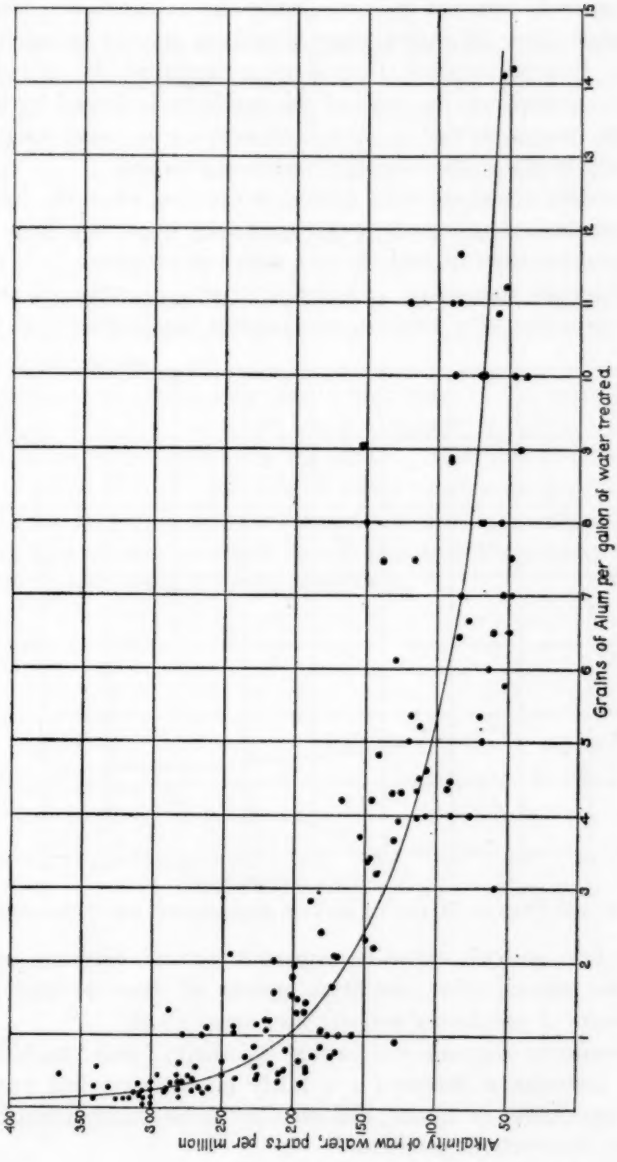


FIG. 3. 150 TYPICAL DAILY READINGS; ALKALINITY AND ALUM

The diagram showing "turbidities" compared with "grains of alum," figure 2, does not indicate clearly any particular law, though a suggestive curve, is shown, more based on general knowledge of the plant than determined from a close study of the turbidities. This is not surprising, for most of the turbidity is caused by heavy suspended matter carried by the high velocity in flood stage and quite ready to settle when brought to reasonable rest.

Occasionally a bad colloidal condition obtains, when the hydrate of alumina finds hard work to perform, but there has been little opportunity to study it carefully as a separate problem.

The diagram comparing "alkalinity" with "grains of alum," figure 3, indicates very nicely a relationship that permits the selec-

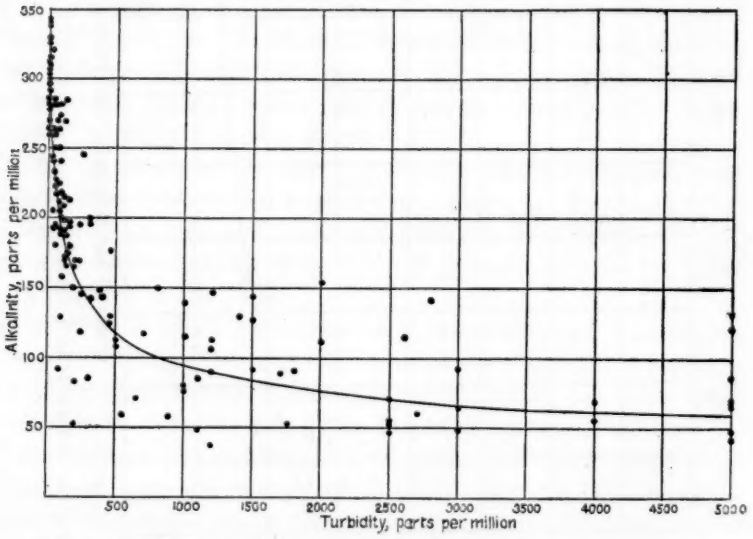


FIG. 4. 150 TYPICAL DAILY READINGS; ALKALINITY AND TURBIDITY

tion of a fair, smooth curve to represent normal working, except when some special river condition upsets all theories and gives several hours of perplexing activity and experiment.

The remaining diagram, comparing "alkalinity" and "turbidity," figure 4, indicates a chance for a fairly good curve, but one not specially conclusive in nature, and possibly to be changed materially as further observations are made.

The higher alkalinities prevail generally in the winter season, during the lowest river stages, when turbidities would naturally not

run high, even with fair-size floods, for frozen lands do not yield so readily to erosion.

In all of the 150 records taken for plotting, the effluents were reported as having zero turbidity.

It is rather an interesting commentary on human nature, however, that while the water company has furnished safe filtered water for twenty years and brilliantly clear, sterilized, filtered water for three years, there are still many residents who hold to the rain tanks with roof washings, and shallow back-yard wells. Rates have been held at the low figures established 30 years ago, based on the low schedules of the city of St. Louis. A change, however, must shortly be made, so as to give more adequate return upon the investment in use.

It is often in the smaller plants that some of the most perplexing problems arise for the water works engineer to solve. This plant has been very interesting to the author, for it has illustrated many of the difficulties of operating a water treatment system and well repaid his occasional trips to examine its workings, suggest improvements, and generally consult face to face with the operating officials, during 20 odd years of advisory service.

RECORDS OF INSTALLATION AND MAINTENANCE OF WATER MAINS AND APPURTENANCES OF THE MUNICIPAL DISTRIBUTION SYSTEM OF THE CITY OF NEW YORK[1]

By William Hauck

The following is a brief description of the procedure followed and records made, in connection with the installation and maintenance of water mains and appurtenances of the municipal water supply system of the city of New York. This work is under the Bureau of Water Supply of the Department of Water Supply, Gas and Electricity.

Requests for mains are noted on forms provided for that purpose and generally spoken of as project sheets. The outlines of the locations with the existing and proposed mains, etc., are shown in sketches at the top of these sheets and all the data as to requirements and conditions are filled in, using spaces provided for the purpose. Special local information is noted under "remarks." These sheets take a prescribed course and are eventually combined and included in a contract or filed for future reference, depending upon whether they are approved or disapproved. Complete record is kept of these sheets in books provided for that purpose.

When necessity requires it, an order is issued to the Division of Investigation and Design to prepare a contract for laying mains, etc., in certain locations. The plans which were prepared in accordance with the project sheets are then combined and a title page added. The bids for the work are received on the percentage basis, i.e., the contractor is required to bid a percentage of the unit prices fixed by the engineer for each item. The bids are noted for general information on tracings known as "bid sheets," giving the names of the bidders, together with the unit prices estimated and bid. When the stipulated preliminaries are fulfilled the borough engineer is directed to see that the contract is executed. In the case of a furnishing, delivering and laying contract, three copies of a requisi-

[1]Read before the St. Louis Convention, May 16, 1918.

tion covering the material required are prepared; one is sent to the contractor and the other two to the inspection division, which in turn, issues orders to its foundry inspectors to inspect the cast ings during and after manufacture. Reports of these inspections, in duplicate, giving the numbers and weights of castings (R being used to indicate rejections) are forwarded regularly, one copy being filed in the inspection division and one with the engineer in charge of the contract.

Progress on the contracts is noted on the print or prints kept for that purpose, the pipe, etc., laid being indicated by marking with red crayon. A plan or plans is sent to the foreman in whose district the work is to be done, and he is at the same time informed as to the engineer in charge of the work and from whom he is to take orders as to shut-offs, etc.

Inspectors assigned to the field work keep field books, noting therein daily all work done, force employed and sketches showing details of connections. All numbers and weights of castings received or borrowed from or sent to the department yards are noted in these books and later transcribed on daily report forms provided for this purpose and delivered to the borough headquarters.

The engineers in charge of field work keep records of pipe laid, drawn to scale on cross-sectioned cards, 5 by 8 inches, one card for pipe, castings, etc., and a corresponding card for trench excavations, showing the location of the pipe in relation to the curb, the cover on the pipe, class of excavation, pavement and any other details that are essential in connection with properly preparing the estimate for payment for work done.

A monthly report of the work done is prepared showing the progress, which is also graphically shown by plotting a curve, a required-progress curve having been previously established in accordance with the time allowed for the completion of the contract and estimated cost, etc.

All castings are numbered and weighed at the foundry and these weights and numbers are used for identification of these materials until they are placed in the work or delivered at one of the designated department yards. Loose leaf sheets, 13 by 16 inches, are used for keeping records of cast iron material and, also, for working out from the field sheets the remaining items of the contract. The ruling is the only difference in these sheets. The casting sheets are ruled vertically and horizontally and rubber stamps are used to

designate various materials. The remaining items are figured on sheets ruled horizontally only, no rubber stamps being used.

Approximate estimates of work done are prepared from time to time, but not oftener than once a month, and are forwarded on sheets especially prepared for the purpose.

Notes on pipe, etc., installed are copied by the draftsmen on a map, on a scale of 1 inch to 300 feet (known as the wall map), on 27 by 40-inch tracing maps having an approximate scale of 1 inch to 100 feet and in turn copied on field and headquarters maps of emergency engineers, on maps of the Water Waste Investigation force, the maps used by all foremen, and also on the maps which are carried on each repair vehicle.

When all of the work on a contract has been completed, accurate drawings, on a scale of 1 inch to 40 feet, are prepared as a permanent record.

The city is divided into repair districts, the size of the district depending on the maintenance involved. The clerk in each headquarters sends daily to the borough main office a copy of his blotter. Every individual piece of work done by the repair company force is designated by a job number. Weekly he sends a report of work done that affects the maps. This is checked with his daily reports, and maps and records corrected accordingly. In addition to the blotter the clerk keeps a book, known as the complaint record, in which complaints are recorded, the final disposition being noted.

The records of taps inserted and also plugs used to replace taps are kept on $3\frac{3}{4}$ by 6-inch cards; all details as to the location with reference to curb and house lines, size of the mains, depth of cover on the main, plumber's name, tapper's name, etc., are noted. The same cards are used to record the house service inspections.

A staff of draftsmen and clerks is continually employed in keeping up to date the numerous maps and various office records. The district companies are visited regularly by a junior draftsman in order to keep the maps up to date within a week. The office maps are kept up to date daily.

THE PROPERTY OF CERTAIN WATERS WITH REFERENCE TO THEIR ACTION ON METALS[1]

By S. W. Parr

The waters of this region have certain peculiarities which show themselves more especially in steam generation and steam heating appliances. For this reason their properties and behavior have been largely overlooked. These waters are classified as alkaline, meaning thereby that they have present free sodium carbonate or more than enough sodium to unite with the sulphate, chloride, and nitrate radicals or ions. There is left, therefore, only carbon dioxide, CO_2, to unite with the remaining sodium and also all of the calcium, magnesium and iron. Such waters have only temporary hardness, there being no sulphates of calcium or magnesium.

Now it so happens that the Champaign-Urbana water supply was the first water of this type to come into use or, indeed, to the notice of water chemists, who were at first rather reluctant to report free sodium carbonate in conjunction with carbon, magnesium and iron, as being an incompatible combination. However, it is seen at once that all of the carbonates are in the bicarbonate form and while readily soluble in the cold are readily decomposable on the application of heat. This water supply for the two cities was brought into use about 1884. It comes from the drift at about 165 feet below the surface. Since the first development of this type of water in 1884 the local area has been greatly extended. As a result of a study, about 1900 to 1905, of the water supplies of the Illinois Central, the Chicago & Alton and the Big Four Railroads between Peoria and Indianapolis an area producing such waters could be roughly indicated by drawing a line from a point somewhere between Paxton and Gilman on the Illinois Central Railroad, proceeding westward to include Normal, thence southward through the center of Bloomington somewhere between the Chicago & Alton junction and the pumping station of the Big Four Railroad near Center Street, thence south and east to include Bement, Tolono, Philo, Veedersburg, Ind.,

[1] Read before the Illinois Section, April 17, 1918.

and thence westward again to include Hoopeston and Paxton, the starting point. In addition to this area the Illinois State Water Survey has found waters of this type very widely distributed and far more commonly in use than when the supplies came from shallow wells. Bulletin 4 of the Illinois State Water Survey gives the distribution of such waters throughout the state.

In order to understand some of the unusual or unsuspected properties of these waters it will be well to note some of the reactions involved when these waters are in use in steam generators. The first stage in the decomposition of the bicarbonate by heat would of course be the simple reaction:

$$2(NaHCO_3) = Na_2CO_3 + CO_2 + H_2O.$$

However, a study of the actual conditions in the boiler showed that the reaction did not stop here, but a partial hydrolization of the sodium carbonate occurred, thus:

$$Na_2CO_3 + H_2O = NaHCO_3 + NaOH.$$

It will thus be seen that the residual water within the boiler becomes an active reagent for the precipitation of fresh incoming bicarbonates, thus indicating why such waters are self-purging and develop no scale whatever within the boilers. In this discussion, however, the author wishes to call attention to another reaction which accounts for the liberation of ammonia as a gas along with the steam: thus:

$$NaOH + NH_4Cl = NaCl + NH_3 + H_2O$$

Now a word as to the extent to which ammonia may be delivered under the conditions such as are found in the local water supply. If we take, for example, the local power station of the Illinois Traction System, which uses approximately 100,000 gallons of water per day, then on the basis of 0.1 pound of ammonia as NH_3 per 1000 gallons of water, the output would be 10 pounds per day or in the form of ammonium carbonate, 50 pounds daily. Of course, upon cooling, a combination of the ammonia and the carbon dioxide occurs forming the ammonium carbonate salt. Evidence of this is occasionally shown in the complete stoppage of risers in dwellings where the steam has been shut off for some time. This phenomenon has already been reported to this Association and is illustrated by photograph in the *Proceedings* of the Association for 1911, page 61.

This brings us directly to an explanation for a serious corrosive

action which occurs in the heating system of the University, especially in connection with the brass parts of the steam traps to the radiators. The number of these parts thus affected would have to be expressed by 3 figures, but no very exact data are at hand showing the approximate number.

In making a study of the conditions that accompany these failures, it was found that in those buildings where the return water was most strongly impregnated with ammonia, the corrosive action was greatest. These variations in the content of ammoniated condensate that accumulates in certain buildings to a greater extent than in others is a peculiarity that is found to exist also with the variation in content of carbon dioxide gas that accumulates in the radiators.

So far no explanation for these variations has been found, other than that due to their place on the line or the method of taking off the steam supply from the mains. These features however are not essential to the main fact that the condensation water becomes sufficiently impregnated with ammonia to become a strongly corroding reagent for brass.

SOCIETY AFFAIRS

ADDITIONS TO MEMBERSHIP

Active

Sylvester Quayle Cannon, Manager Water Works, Salt Lake City, Utah.

Cornelius M. Crowley, Registrar Water Department, St. Paul, Minneapolis.

Homer V. Knouse, Metropolitan Water District, Omaha, Nebraska.

Edgar A. Rossiter, Civil Engineer, Chicago, Illinois.

William M. Willetts, Murphysboro Water Works, Electric and Gas Company, Aurora, Illinois.

Corporate

Board of Water Commissioners, Glens Falls, N. Y.

DEATHS

John H. Decker, elected member July 18, 1907; died October 10, 1918.

Holly, Ira A., elected member March 29, 1881; Honorary Member; died September 19, 1918.

William F. Woodburn, elected member June 24, 1903; died September 16, 1918.

ROLL OF HONOR

ANDERS, F. L., Captain, Construction Division, U. S. A., Camp Dodge, Iowa.

BAIR, MAURICE Z., Captain, Construction Division, U. S. A., Washington, D. C.

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CHIPLEY, DUDLEY, Captain, Quartermaster Corps, U. S. A., in charge Utilities, Camp Hancock, Georgia.

COOK, HORACE J., Captain, Quartermaster Corps, U. S. A., Camp Cody, New Mexico.

DALLYN, F. A., Captain, Canadian Expeditionary Forces, Siberia.

EVERETT, CHESTER M., Captain, Sanitary Corps, U. S. A., Fort Oglethorpe, Georgia.

EVINGER, M. I., Captain, Quartermaster Corps, in charge Utilities, Camp Dodge, Iowa.

GREGORY, JOHN H., Captain, Sanitary Corps.

HOAD, WILLIAM C., Lieutenant Colonel, Sanitary Corps, U. S. A., Washington, D. C.

HOOPES, EDGAR M., Jr., Captain Quartermaster Corps, U. S. A., Camp Meade, Maryland.

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JOHNSON, EDGAR W., 5th Pioneer Infantry, A. E. F., France.

KELLY, EARL W., Engineer, American Expeditionary Force.

LEVY, A. G., Captain, Quartermaster Corps, U. S. A., Camp McArthur, Texas.

RACE, JOSEPH, Captain Canadian Army, Hydrological Corps, Russia.

STOVER, FREDERICK H., First Lieutenant, Company B, 26th Engineers, A. E. F.

TROW, LINDEN C., Quartermaster Corps, Utilities Division, Camp Grant, Illinois.

JUNIOR ROLL OF HONOR

HEERMANS, DONALD (son H. C.), 25th Battery, Field Artillery Corps, O. T. S., Camp Taylor, Kentucky.

HEERMANS, JEROME T. (son H. C.), Lieutenant 25th Field Artillery, Camp McClellan, Anniston, Alabama.

HEERMANS, JOSEPH F. (son H. C.), 36th Prov. Squad., Joyce, Wyoming.

HENDERSON, ERNEST M. (son C. R.), Second Lieutenant, Infantry, St. Louis, Mo.

WILLIAMS, ALLEN H. (son H. L.), 6th U. S. Coast Guard, Battery Barge Office, New York.

SUBJECT INDEX

Accounting for interest and taxes, 40
Air lift, Camp Grant, 104
  Savannah, 255
Alabama, water supply standard, 50
Alum, method of using, St. Louis, 281
American Water Works Association, advantages of a local section, 167
  amendments to the constitution, 355
  annual convention, 363

Bacteria, degree and nature of removal in filters, 272
  differentiation of species of the colon-aerogenes family, 26
  notes on the presumptive test for B. coli, 168
  practicability of bacterial standards of quality of water, 198
  reduction at Council Grove, 443
  standards for water, 49, 198

California, water supply standards, 51
Calking lead wool and cast lead joints, 10
Camp Grant water supply, 100
Cantonment water supplies, Camp Custer, 229
  Camp Grant, 100
  sanitary aspects, 232
Carbon dioxide, removal from water, 185
Catskill water supply system, 91
Chloramine, 63
Chlorination, chloramine and, 63
  Minnesota problems, 132
  St. Louis, 284
City planning, report of committee, 1
Coagulant, successive applications at Council Grove, 438
Coal, burning small sizes of anthracite, 401
  purchasing under Fuel Administration, 402
Cocks and services, head lost in corporation, 240
  joints, 407
Comments, 193, 395
Committee reports, amendments to the constitution, 355

Committee reports—*continued*
  city planning, 1
  executive, 375
  finance, 376
  mechanical analysis of sand, 345
  priorities, 194
  publication, 380
  sanitary drinking fountains, 110
Concrete pressure pipe, reinforced, 419
Constitution, amendments, 345
Contracts, dehydrated, 404
Convention, St. Louis, 363
Council Grove, Kan., water treatment, 438

Dams, drainage and sectional construction of concrete, 96
Deaths, 84, 191, 454
Dehydrated contracts, 404
Differentiation of bacteria of the colon-aerogenes family, 26
Drawings for photo-engraving, 400
Drinking fountains, sanitary, 110

Executive committee, report, 375

Filtration, laboratory control methods, 223
  nature of bacterial removal by, 272
  significance of black sand, 425
  St. Louis, 284
Finance committee, report, 376
Fish life and water pollution, 434
Flag, service, 363
Fountains, sanitary drinking, 110

Gate houses, architectural treatment, 1

Head lost in corporation cocks and services, 240
High-pressure fire-service pipe leakage, 44

Illinois section, 190, 371
Inspection to prevent waste, 396
Interest, accounting for, 40
Iron, removal from water, 185
Iowa, water supply standards, 51

Joints in pipes, flanged, 410
lead wool and cast lead, 10
metalium, 174
water tight for vitrified pipe, 16
Journal, 193, 381, 395

Labor-saving machinery, 172, 301
Labor under war conditions, 303
Laboratories of American water works, 133
practice in B. coli tests, 201
Lead wool, 10
Lead pipe couplings, 407
Leakage, vitrified pipe under low head, 15
Catskill aqueduct tunnels, 97
high-pressure fire-service mains, 44
services, 408
Lime, methods of use, St. Louis, 280
Little Falls, Minn., water works, 165
Local sections of the Association, advantages, 167
Lowering ground water levels in trenches, 36

Manganese, removal from water, 185
Manifold for 48-inch mains, St. Louis, 288
Mankato, Minn., artesian wells, 163
Maps, distribution system, St. Louis, 414
Passaic Water Company, 433
New York, 450
Maryland, water supply standards, 51
Membership changes, 84, 190, 454
Metalium, 174
Meters, methods of determining and plotting capacities, 120
results of use at Oak Park, 263
Minneapolis, centrifugal pumps, 118
Minnesota, section, 83
water standards, 50
Montana, water standard, 51

New members, 84, 190, 454
New York, N. Y., Catskill water supply system, 91
leaks form high-pressure fire-service mains, 44
New York section, 83

Oak Park, Ill., water waste elimination, 263
Obituary notices, 84, 191, 454
Office records, distribution system, New York, 448
Passaic Water Company, 429
St. Louis, 412
Ottawa, P. Q., chloramine treatment, 78

Pipe, cast iron, prices and depreciation, 145
incrustation and tuberculation, 147
tentative draft of proposed standard specifications, 385
Pipe, high-pressure fire-service, leakage, 44
Pipe joints, flanged, 419
lead wool and cast lead, 10
metalium, 174
water tight for vitrified pipe, 16
Pipe, reinforced concrete pressure, 419
Pipe, service, loss of head in, 240
thawing frozen, 166
Pipe, steel, Catskill aqueduct, 96
deterioration of well casing at Mankato, 162
St. Louis, 300
Pipe, vitrified, leakage under low head, 15
Pipe, wood stave, 107
President's address, 250
Pressure tunnels, Catskill aqueduct, 97
Prices, cast iron pipe, 145, 313
Priorities for water works material, 194
Publication Committee report, 380
Publicity of water departments, 57, 62
Pumps, Camp Grant, 105
centrifugal, 115
recovering a lost deep-well pump, 142
St. Louis, 288, 293

Records, distribution system, Passaic Water Company, 429
New York, 448
St. Louis, 412
Recovering a pump lost in a deep well, 142
Reservoirs, landscape architecture about, 1
Roll of honor, 85, 191, 454

Sand, mechanical analysis, 345
Sanitary drinking fountains, 110
Sanitation, shipyard, 194, 230
Savannah, Ga., history of artesian water supply, 252
Screenchamber, new type, 181
Sections, advantages of local, 167
Illinois, 190, 371
Minnesota, 83
New York, 83
Sedimentation, St. Louis, 283
Service flag, 364
Service pipes, thawing frozen, 166
joints, 407

Shipyard sanitation, 194
Sieves and screens for sand, 347
Siphons, inverted, Catskill aqueduct, 96
Society affairs, 83, 190, 363
Specification for cast iron pipe and fixtures, proposed, 385
Standpipes, architectural treatment, 1
St. Louis, double 48-inch manifold, 288
new 110-million gallon pump, 293
office records and maps, 412
proceedings of convention, 363
some aspects of chemical treatment, 279
work of distribution section, water division, 299

Taxes, accounting for, 40
Tidal interference with artesian wells, Savannah, 259
Trenches, labor saving machinery for, 172
lowering ground water level, 36
thawing frozen ground for excavation, 301
Tuberculation of cast iron pipe, 147
Tunnels, Catskill aqueduct system, 96

Virginia, water supply standard, 50
Vitrified pipe, leakage under low head, 15

War burdens of water works, 303
Water, accounting for public uses, 40
pollution and fish life, 434
Water Supply, Camp Grant, 100
cantonments, 232
corrosive action on metals, 451
northern Illinois ground, 100
practicability of adopting standards for, 198
Savannah, Ga., 252
standards and their improvement, 49
sulphur and iron in, 164
Water treatment, chlorination and chloramine, 63
coagulant applied at successive stages of sedimentation, 438
Minnesota problems, 132
removal of iron, manganese and carbon dioxide, 185
St. Louis, 279
Water waste, inspection to prevent, 396
prevention at Oak Park, 263
Water works, Camp Grant, 100
laboratories, 133
management problems of small, 165,
war burdens of, 303
Wells, artesian, Mankato, 163
artesian, Savannah, 253
Camp Grant, 102
lowering ground water in excavating by, 36
recovering a pump lost in a deep well, 142
Writing for publication, 398

Zeolites, for removing iron and manganese, 189

AUTHOR INDEX

ACKERMAN, J. WALTER, accounting for taxes, 41
ALVORD, JOHN W., lowering ground water levels, 38
APPLEBAUM, SAMUEL B., removal of iron, manganese and carbon dioxide, 189

BARRETT, CHARLES F., incrustation of pipe, 157
BARTOW, EDWARD, removal of iron and manganese, 188
  water supply standards, 61
BIRDSALL, L. I., publicity for water departments, 62
BLEISTEIN, BERNARD J., loss of head in corporation cocks and service pipes, 240
BLOMQUIST, H. F., some features in artesian well construction in Mankato, 163
BOHMAN, HENRY P., accounting for public water, 42
BOWLES, LIEUT.-COL. JAMES T. B., sanitary aspect of the water supplies of army cantonments, 232
BRUSH, WILLIAM W., accounting for interest and taxes, 40
  conservation of water supply by water waste prevention inspection, 396
  leakage from vitrified pipe used to convey water under a low head, 15
  lowering ground water levels, 37
BURDICK, CHARLES B., water works at Camp Grant, 100

CAPPELEN, F. W., advantages of a local section, 167
CHESTER, J. N., tuberculation of pipe, 155
CLARK, WILLIAM MANSFIELD, differentiation of bacteria of the colon aerogenes family, 26, 33
Committees, amendments to the constitution, 355
  city planning, 1
  executive, 375
  finance, 376
  mechanical analysis of sand, 345
  priorities, 194
  publication, 380
  sanitary drinking fountains, 110
  war burdens of water works, 303
CONANT, E. R., history of the artesian water supply of Savannah, 252
CONNET, F. N., tuberculation of pipe, 161
CUDDEBACK, A. W., memoranda of office records, 429
  what interests water works men most, 395

DAILY, C. M., double 48-inch manifold, St. Louis, 288
DAVIS, CARLETON E., burning small sizes of anthracite, 400
  the Journal, 193
DAVIS, E. E., incrustation of pipe, 157
DAY, L. A., new 110-million gallon pump, St. Louis, 293

FLAHERTY, THOMAS E., office records of the St. Louis water division, distribution section, 412
FOLEY, W. A., some phases of the work in the distribution section of the water division, St. Louis, 299
FOLWELL, A. PRESCOTT, lowering ground water levels, 38

GOODELL, JOHN M., coal, 402
  shipyard sanitation, 194
  writing for publication, 398
GORDON, T. G., problems of a small water works plant, 165
GRAF, A. V., some aspects of chemical treatment at the St. Louis water works, 279
GREELEY, SAMUEL A., water supply and sanitation at government camps and shipyards, 229
GREEN, F. W., differentiation of bacteria of the colon aerogenes family, 33
  water supply standards, 59
GREENSFELDER, ALBERT P., dehydrated contracts, 404

HAUCK, WILLIAM, records of installation and maintenance of water mains and appurtenances of the municipal distribution system of the city of New York, 448
HERING, RUDOLPH, incrustation of pipe, 156
HINMAN, JR., JACK J., American water works laboratories, 133
HODGMAN, BURT B., prices and depreciation of cast iron pipe, 145
HOWELL, R. B., accounting for interest and taxes, 40

JENSEN, J. A., labor saving machinery, 172
lead pipe couplings, 406
JUDD, W. A., recovering a pump lost in a deep well, 142

KIMBALL, FRANK A., accounting for public water, 43
KIRK, CLARENCE L., lowering ground water levels, 36, 38
KNOUSE, HOMER V., metalium, 174

LANCE, JOHN H., new design of screen chamber, 181
LEISEN, MAJOR T. A., president's address, 250
LEVINE, MAX, notes on the presumptive test for B. coli, 168

MACHEN, HENRY B., leaks from high-pressure fire-service mains, 44
MAIN, GEORGE A., accounting for public water, 42
incrustation of pipe, 156
MATTE, H. P. T., water waste elimination at Oak Park, Ill., 263
MAURY, DABNEY H., lowering ground water levels, 38
MERIWETHER, COLEMAN, reinforced concrete pressure pipe, 419
METCALF, LEONARD, price and depreciation of cast iron pipe, 158
MOHLER, B. M., water purification problems, 132
MORSE, ROBERT B. (with Abel Wolman), practicability of adopting standards of quality for water supplies, 198

NELSON, FRED B., methods of determining and plotting meter capacities, 120

ORCHARD, WM. J., water supply standards and their improvement, 49

PARR, S. W., property of certain waters with reference to their action on metals, 451

RACE, JOSEPH, chlorination and chloramine, 63
differentiation of bacteria of the colon aerogenes family, 33
removal of carbon dioxide, 188
water supply standards, 61

SHELFORD, VICTOR E., water pollution and fish life, 434
SMITH, J. WALDO, Catskill water supply system, 91

THOMAS, R. J., lead wool, 10
TRIBUS, LOUIS L., water treatment at Council Grove, Kan., 438

WELKER, J. E. (with C. C. Young), significance of black sands in filters, 425
WESTON, ROBERT SPURR, removal of iron, manganese and carbon dioxide, 185
WIGLEY, CHESTER G., water supply standards, 59
WOLMAN, ABEL (with Robert Morse), practicability of adopting standards of quality for water supplies, 198
preliminary analysis of the degree and nature of bacterial removal in filtration plants, 273

YORK, E. C., centrifugal pumps, 115
YOUNG, C. C. (with J. E. Welker), significance of black sands in filters, 425

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(Trade Mark)

BACTO-PEPTONE

THE ORIGINAL STANDARDIZED PEPTONE
FOR BACTERIOLOGY

PREPARED from basic materials carefully selected and assayed.

PROCESSED under scientific methods of factory control.

STANDARDIZED by precise chemical and bacteriological tests.

ADJUSTED to give a definite H-ion concentration in solution.

INDOL REACTION assured by a constant tryptophane factor, and gauged to a positive indication in twenty-four hours.

NITROGEN content never less than 15.2%, in the form of molecules ideally adapted for bacterial nutrition.

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Bacto-Peptone stands on its own merits and completely substantiates all claims made for it.

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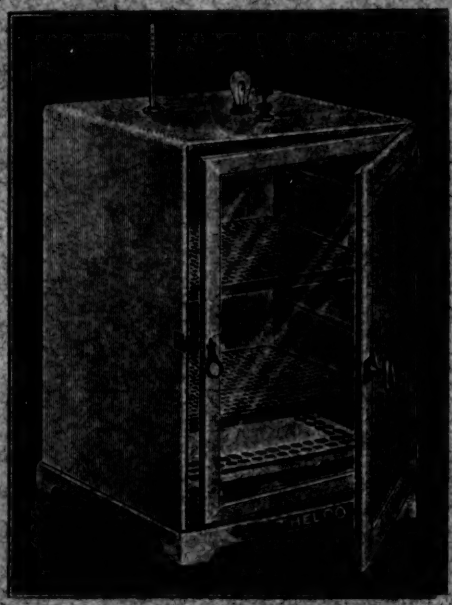
THELCO INCUBATORS



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Thelco Bacteriological Incubators are built of well seasoned heavy oak, finished inside and outside with white paint enamel which can be kept clean by wiping with a moistened cloth. This finish imparts to the incubators a handsome and clean appearance. An inner door of glass is provided to allow inspection of the chamber without opening the door. No water jacket is used or required.

An exclusive feature is the removable wire resistance heating plate. This method of heating is distinctly superior to lamps in that it evenly distributes the heat throughout the chamber; furthermore, it will not burn out to cause spoiling of cultures, annoyance and inconvenience, that is so apt to happen when lamps are employed as a heating medium.

The Thelco bi-metallic Thermostat employed will maintain the temperature constant to within a degree without any attention after adjustment is once made.

The Operation is very simple. To place the incubator in use, it is only necessary to screw the attachment plug into an electric light socket and turn on the current; then adjust the regulator until the thermometer reaches the temperature desired, which will remain constant to within a degree. The incubator can be operated on direct or alternating current.

When ordering please state voltage of current

No.	Dimensions of Chamber	Equipment	Price, Net
	Inches		
2	12 x 12 x 12	Without Stand	$ 38.50
4	18 x 18 x 26	Without Stand	62.50
5	18 x 18 x 26	With Stand	76.50
6*	28 x 36 x 18	Without Stand	110.00
7*	28 x 36 x 18	With Stand	128.00

*Incubators Nos. 6 and 7 are made with double divided doors.

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